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Index to Volume XXXVI

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BRITISH COLUMBIA HYDROELECTRIC DEVELOPMENTS

THE METEOROLOGICAL CONDITIONS CAUSING
THE FLOOD OF 1894 AND LOW STAGES IN
THE COLUMBIA RIVER IN 1890 AND 1912

BY EDWARD A. BEALS.

THE NEED FOR A CONSISTENT GENERAL STATE
POLICY AS TO PUBLIC UTILITIES

BY CLYDE B. AITCHISON.

DIESEL ENGINE PRACTICE

BY J. E. MEGSON AND H. S. JONES

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VOLUME XXXVI

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Natural Reservoirs for British Columbia Power Supply.

BRITISH COLUMBIA HYDROELECTRIC DEVELOPMENTS

(Brief description is here given of the various waterpower plants of British Columbia. The text has been condensed from a report by G. R. G. Conway prepared for the water power branch of the Canadian Department of the Interior.—The Editor.)

The Province of British Columbia has a superficial area of 372,640 square miles, and within its boundaries there are vast undeveloped resources of mineral and timber wealth. The value of these great resources of wealth is enormously increased by long Pacific coast line with its numerous excellent harbors, with the great navigable rivers and lakes, great railway systems, and by numerous water powers that are capable of development for the transmission of electrical energy over practically the whole of the mining, industrial and populated areas of the Province.

One of the most remarkable features of the coast are the fiords and passages which are analagous to those of Scotland and Norway, and probably surpass those of any part of the world in dimensions and complexity, with perhaps the exception of those in Greenland. The great height of the rugged mountain walls which border them also gives them a grandeur quite their own. The unique position of British Columbia as a watershed on the Pacific coast of America will be at once recognized when it is understood that all the rivers of great importance on that coast, with the exception of one, the Colorado, rise from within its boundaries. The drainage from its extensive area of

mountains and highlands is received into the numerous lakes, thence the surplus is discharged into the few large rivers or their tributaries which finally reach the sea. The principal of these rivers are the Columbia on the south which flows through American territory into the Pacific Ocean, the Fraser River, 750 miles long, the Skeena, 300 miles long, and the Stikine on the west, the Liard, over 300 miles in British Columbia on the north, and the Peace River, over 300 miles in British Columbia, on the east. These rivers are of great size and volume and the first four are sufficiently navigable to steamers to form water ways of no small value in the development of the Province.

The area occupied by the principal lakes of the Province amounts to 2439 square miles.

The submerged mountain range which lies to the west of the mainland is represented by an archipelago of islands, the most prominent being Vancouver and the Queen Charlotte Islands. Of the others, it may be briefly stated that they produce in miniature all the physical features of the larger group.

The development of hydroelectric plants on a fairly large scale began in British Columbia as early as 1897. The first plants of any magnitude were those

at Bonnington Falls on the Kootenay River near Nelson, B. C., and the Goldstream plant of the British Columbia Electric Railway on Vancouver Island. These plans were under construction simultaneously, but the Bonnington Falls plant can claim priority as it was placed in operation early in 1898, while the Goldstream plant was first operated in September of the same year. Since that date large plants have been installed for the production of electrical energy for the cities of Victoria and Vancouver, and for the manufacture of pulp, and in the mining industry. The following is a list of some of the principal developed water powers which will be described in detail later:

Within reasonable distance of Vancouver and Vic-

\$100 per horsepower, and those powers nearer the lower figure make them as economical possibility for successfully undertaking electro-chemical industries. Considering this fact together with the wonderful possibilities of transport by water freight to the markets, the advantages in competing with less favorable districts is obvious.

The following descriptions will indicate to what extent the waterpower resources of the Province have already been developed, and will give the reader some idea of their application at the present time.

est and most important development in the interior of British Columbia, and furnish power and light to the cities of Trail, Rossland, Grand Forks, Phoenix, Greenwood, Boundary Falls and other municipalities within

Capacity of the Principal Water Powers as at Present Developed in the Province of British Columbia.

Owner.	Situation.	Present capacity installed horsepower.	Purpose for Which Energy Is Utilized.
West Kootenay Power & Light Co., Ltd.	Kootenay River and Kettle River, near Nelson	23,000	Mining, smelting, light and industrial power.
British Columbia Elect. Ry. Co., Ltd.	Goldstream, near Victoria	3,000	Light, industrial power and street railways.
British Columbia Elect. Ry. Co., Ltd.	Lake Buntzen, Burrard Inlet	84,500	Light, industrial power and street railways.
Western Canada Power Co., Ltd.	Stave Lake, near Ruskina	26,000	Industrial power (26,000 h.p. now being added).
British Columbia Elect. Ry. Co., Ltd.	Jordan River, Vancouver Island	25,000	Light, industrial power and street railways.
Ocean Falls Co., Ltd.	Link River, Ocean Falls	11,200	Wood pulp and lumber manufacture.
Canadian Collieries (Dunsmuir), Ltd.	Puntledge River, near Nanaimo	9,400	Coal mining.
Powell River Co., Ltd.	Powell River	24,000	News print paper manufacture.
Granby Consolidated M., S. & P. Co., Ltd.	Falls Creek, Granby Bay	7,325	Copper mining and smelting.
City of Nelson	Kootenay River, near Nelson	4,000	Mining, industrial power and light.
City of Kamloops	Barriere River, near Nelson	2,800	Light and industrial power.
Britannia Mining & Smelting Co., Ltd.	Britannia Creek, Howe Sound	2,735	Copper mining and reduction.
Hedley Gold Mining Company	Similkameen River, near Hedley	2,650	Gold mining.
City of Prince Rupert	Woodworth Lake, nr. P. Rupert	1,650	Light and industrial power.
Swanson Bay F., W. P. & Lbr. Mills, Ltd.	Swanson Bay	1,250	Wood pulp and lumber manufacture.
City of Revelstoke	Illecilliwaet River, nr. Revelstoke	600	Light and industrial power.
Other small developments		890	Mining, municipal and hotel lighting, salmon canning.
Total horsepower at present installed		230,000	

toria there are possibilities of the economic development of water powers aggregating 750,000 h.p. These water powers are all situated within an area of 20,000 square miles, thus representing $37\frac{1}{2}$ h.p. for each square mile of territory. Outside of this area a rough estimate of the water power possibilities of the Province would bring this figure up to 3,000,000 h.p., or nearly equal to the estimate, and in the writer's opinion this amount is conservative, although until much further investigations have been made, such an estimate is an intelligent guess.

The capitalist and manufacturer seeking for opportunities of developing new industries, will find a fertile field in British Columbia for utilizing these water powers in addition to their use in supplying electrical energy for cities and towns. Already large Portland cement plants using about 8000 h.p. of electrical energy are in operation on Vancouver Island, paper pulp is being manufactured on a large scale, and smelting plants are being operated by water powers.

In British Columbia, there are in many of the water powers somewhat similar conditions to those that obtain in Scandinavian territory, i.e., powers that can be developed economically under high heads. In the writer's opinion, excluding the cost of transmission lines, many of these including some low head plants, can be developed as complete installations from \$60 to

West Kootenay Power & Light Co., Ltd.

The West Kootenay Power & Light Company, Ltd., owns and operates three hydroelectric generating plants on the Kootenay and Kettle Rivers, having an aggregate capacity of 23,000 h.p.. These are the largest the radius of their transmission lines. In this section of British Columbia the mines and smelters are the lowest consumers of power.

The Kootenay River plants are at Bonnington Falls about 11 miles below the city of Nelson, where the minimum flow at Bonnington Falls is 5850 cu. ft. per sec., and occurs during the months of January and February. The maximum flow of 60,000 cu. ft. per sec. occurs during June and July, when the snow is melting most rapidly.

Space is provided in Plant No. 1 for four main generating units, two exciter units, and for all transformer and switching apparatus to complete the plant. At present, two units are installed. A 30-ton electrically operated overhead travelling crane spans the main generator room, and railroad cars can be brought into the power house on a spur track under the crane.

From Plant No. 1 current is transmitted at 22,000 volts to Rossland, Trail, Nelson and Silver King Mine, where substations are provided. The longest distance over which current at this voltage is transmitted is 32 miles. From Plant No. 2, current

West Kootenay Power & Light Co., Ltd., Hydraulic Plant Equipment.

Turbines.		Generators.		Transformers.	
Bonnington Falls No. 1.....	1-2000 h.p. Victor.	1100 volts.		4 banks, air blast 1100/22000 v.	
	2-1000 h.p. Victor.	Canadian General Electric.		750 kw. Can. Gen. Elec.	
Bonnington Falls No. 2.....	2-8000 h.p. Francis.	2-5625 kw. C. G. E.		3 banks of 3-1875 kw. oil insulated water cooled 2200/60,000.	
				1 bank 3-1250 kw., 2200/22000.	
Kettle River	3-1300 h.p.	3-750 kw.		3 banks of 3-312 kw., 2200/22000	



Bonnington Falls Developments.

at 60,000 volts is transmitted a distance of 81 miles to Greenwood Substation, and to substations at Rossland, Grand Forks, Phoenix and Boundary Falls Substation, which is 84 miles from Bonnington Falls.

The Kettle River Plant, known as No. 3 Plant or Cascade Plant of the West Kootenay Power and Light Company, is located on the Kettle River in the "Boundary District," about 12 miles below the town of Grand Forks.

The generating equipment of No. 3 Plant consists of three units. Current is transmitted at 22,000 volts to substations at Grand Forks, Phoenix, Greenwood and Boundary Falls, the latter substation being 28 miles distant from No. 3 plant.

British Columbia Electric Railway Company.

In 1898 the Goldstream power house, 12 miles from Victoria, was built by the B. C. Electric Railway Company, Ltd. The power house is of brick on concrete foundations, and is situated near the west bank of the lower reservoir, the available static head at the water wheels being 650 ft.

Current is generated at 700 volts, and by means

of air cooled transformers it is stepped up to 17,500 volts, at which it is transmitted over a two circuit single pole transmission line to Victoria, twelve miles distant, where it is received at Rock Bay substation along with energy from the Vancouver Island Power Company's plants at Jordan River and Brentwood Bay.

Coquitlam Lake is the main storage reservoir for two large plants supplying Vancouver and environs, the natural catchment being augmented by a hydraulic fill dam, 1200 ft. long, 655 ft. wide at the base and 100 ft. high. This gives a storage capacity of 180,500 acre feet available for power purposes. New Westminster also obtains its water supply from this source.

Water is conveyed from Lake Coquitlam to Lake Buntzen, the forebay, through a 12,650 ft. tunnel with 192 sq. ft. section, the two lakes being separated by a range of mountains 4000 ft. high. A concrete dam, 54 ft. high and 361 ft. crest at the lower end of the lake gives a 400 ft. head. Ten 54 in. and two 24 in. outlets with trash racks and head gates are provided for the pipe lines which convey water to power house No. 1.

British Columbia Electric Railway Co., Ltd., Hydraulic Plant Equipment.

	Turbines.	Generators.	Transformers.
Goldstream	2-600 h.p. Pelton.	2-350 kw., 1-500 kw.	700/17500 air blast.
	2-1000 h.p. Pelton.	1-1000 kw.	
Lake Buntzen No. 1.....	4-3000 h.p. Pelton.	4-1500 kw. Westinghouse.	3 banks of 3-3000 k.v.a. 2200/84600.
	1-10500 h.p. Pelton.	2-5000 kw. C. G. E.	
	2-10500 h.p. Doble	1-5000 kw. Dick Kerr.	
Lake Buntzen No. 2.....	3 units of 4 Pelton-Doble	3-8900 k.v.a. Dick Kerr 2200	4 banks of 3-3000 kw.. 2200/34000.
	wheels, 13,500 h.p.	volts.	
Jordan River	2-6000 h.p. Doble.	2-400 k.v.a. Allis-Chalmers Bul-	2 banks of 3-1450 k.v.a.
		lock, 2200 volts.	1 bank of 3-3000 k.v.a. 2200/60000 Canadian Westinghouse.
	2-6500 h.p. Pelton-Doble.	1-8000 k.v.a. C. G. E., 2200 v.	

Lake Buntzen Power House No. 1 is situated on the east shore of Burrard Inlet about 16 miles from the City of Vancouver. The power house is built of hewn granite, the main floor being 5 ft. above high water. The original installation has been added to from time to time, and the present equipment having a capacity of 16,500 kw.

The generating equipment is installed on the main floor of the power house, 5 ft. above high water level. The transformers and high tension switching equipment are housed in a separate building behind the power house.

third of a mile to the south of the original power house. It is of reinforced concrete and contains wheels of a total capacity of 40,500 h.p. generators and transformers, together with the necessary high and low tension switching equipment. Water for driving the units is obtained from Lake Buntzen through a concrete lined pressure tunnel 14 ft. 8 in. internal diam-



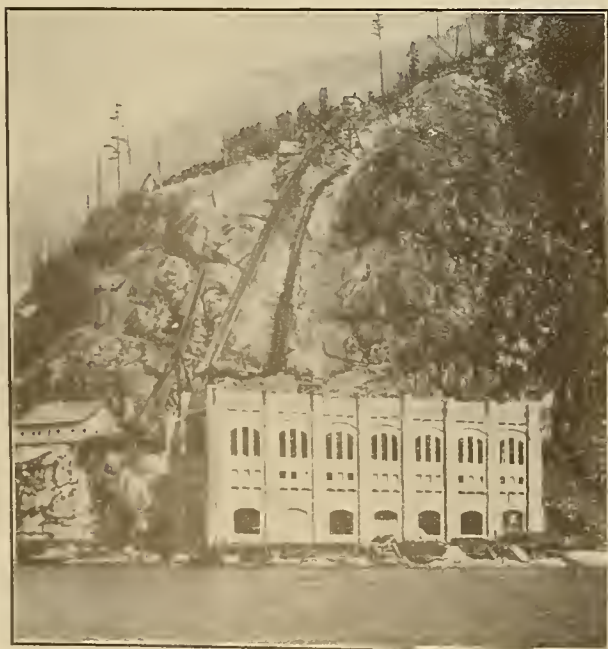
Lake Coquitlam and Coquitlam Dam.

Each of the 1500 kw. units is supplied with water from Lake Buntzen by means of a pipe line 48 in. in diameter and 2000 ft. in length. Two pipe lines 60 in. in diameter are provided for the fifth unit. One pipe line 84 in. in diameter at the upper end and tapering to 72 in. in diameter at the power house, is provided for the sixth unit, and a similar pipe line provides water for No. 7 unit. In the original installation the first 800 ft. of the pipe lines below Lake Buntzen Dam were of wood stave construction. The wood stave portions of these pipes have now been replaced with pipes of riveted steel.

Plant No. 2, Lake Buntzen, is situated about one-

eter and about 1800 ft. long, driven through solid rock and controlled by three Doble needle intake valves placed with their seats on a concrete foundation on the bottom of Lake Buntzen. An outer cylinder is provided which may be lowered down to a horizontal seat, thus excluding water from the needle valves so that they may be inspected without the use of a diver. These needle valves are operated by means of oil pressure.

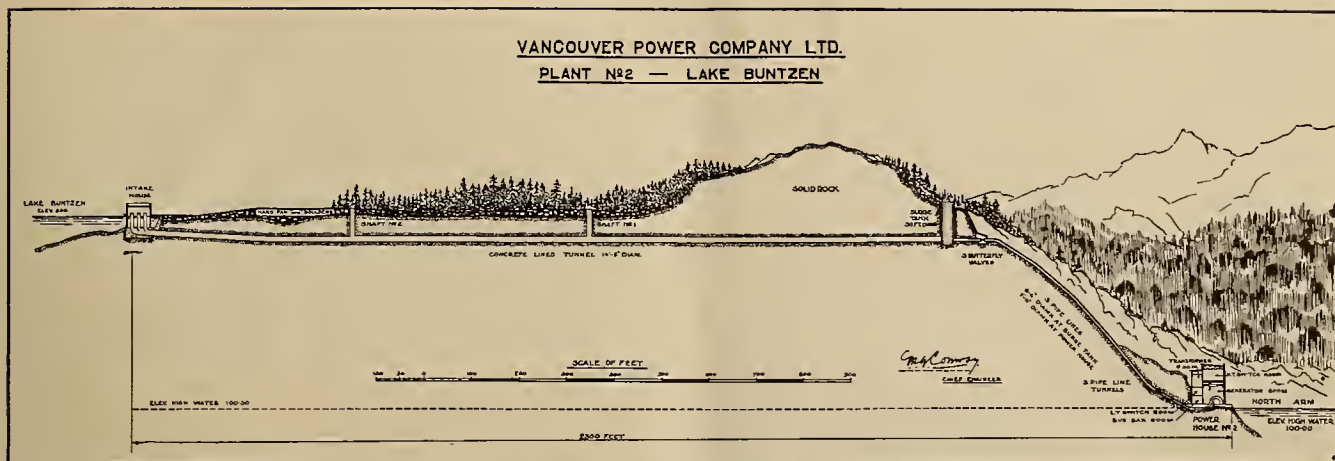
Near the lower end of the pressure tunnel and close to the top of the hill, a steel surge tank 30 ft. in diameter is provided, and from this point the water is conducted to Power House No. 2 through three



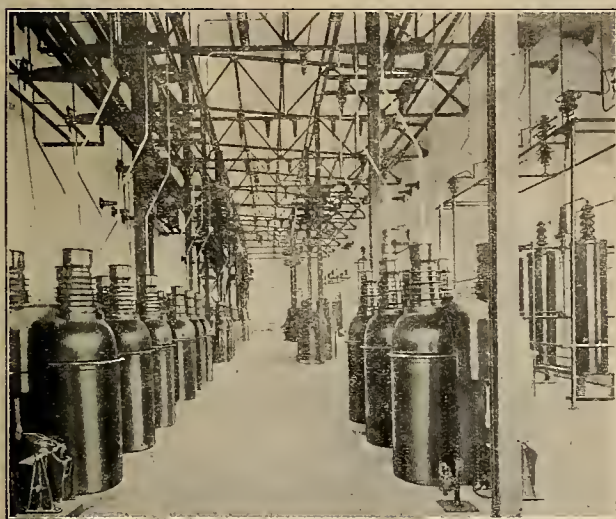
Plant No. 1, Lake Buntzen.



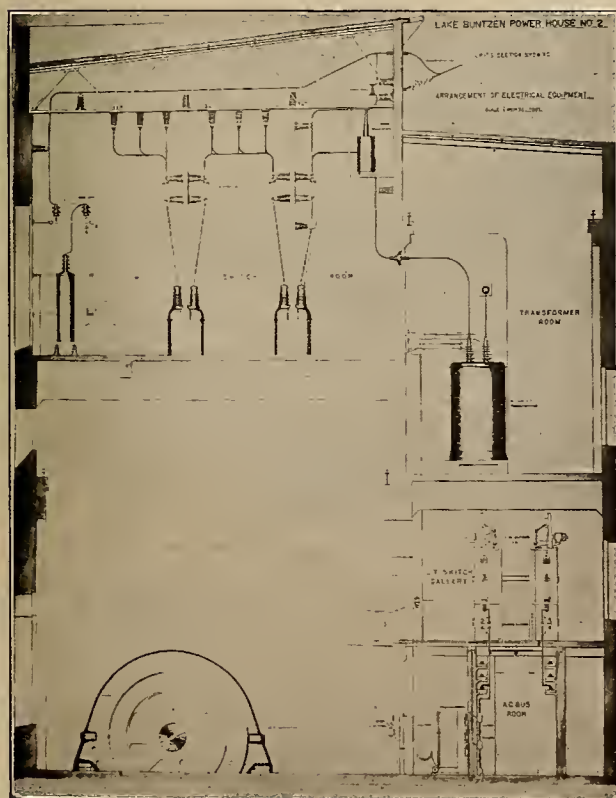
Plant No. 2, Lake Buntzen.



Cross Section of Plant No. 2, Development, Lake Buntzen.



High Tension Switch Room at Buntzen Plant No. 2.



Arrangement of Electrical Equipment at Lake Buntzen Plant No. 2.

steel pipe lines. Close to the surge tank a Pelton Doble Venturi butterfly valve is installed in each pipe line. The pipe lines are connected to the surge tank by means of flanged reinforcing plates. The pipe lines are 8 ft. 6 in. in diameter and $\frac{1}{2}$ in. thick at their upper ends, tapering to a diameter of 7 ft. at the power house, where the thickness is $1\frac{1}{8}$ in. About 200 ft. from the power house the pipe lines pass into tunnels driven through rock. The pipe line grades are steep, the slopes ranging from 28 to 53 degrees, thus rendering difficult the handling of the large pipe sections.

The bus bars are placed in cells in the bus bar room at the level of the main floor, and the voltage is controlled by Tirrill regulators. The low tension generator and transformer switches, which are of the Canadian General Electric H-6 type, are placed in the low tension switchroom situated above the bus bar compartments. The transformer room is situated immediately above the low tension switchroom. The high tension switchroom, which also contains the lightning arrestor equipment, is situated above the generator room; the high tension switches are of the Canadian General Electric K-15 type. All of the low tension and high tension switches are electrically controlled from the operating benchboard which is situated on the operating gallery in the generator room. All of the switches, switchboard equipment, and transformers were supplied by the Canadian General Electric Company. Two 50-ton electrically operated travelling cranes control the entire length of the generator room, and one 25-ton electric crane is provided in the transformer room.

The electrical energy at Lake Buntzen is transmitted at 34,600 volts to substations at Vancouver and to other substations in the territory served by the company, by two 2-circuit transmission lines. Two of these circuits, which are connected in at Plant No. 1, are carried on wooden poles; the other two circuits are outgoing lines from Plant No. 2 and are carried on steel towers. A tie line connects Power Houses Nos. 1 and 2.

The Jordan River plant of the Vancouver Island Power Company, Limited, a company subsidiary to the British Columbia Electric Railway Company, Limited, is situated at the mouth of Jordan River, which flows into the Straits of San Juan de Fuca about 40 miles

west of the City of Victoria, Vancouver Island, the main floor being 7 ft. 6 in. above high tide level. Water is conveyed to the water wheels in the power house from a forebay reservoir through steel pipe lines 9290 ft. long. The forebay, which is a small equalizing reservoir formed by two earth fill dams, is about 1152 ft. above sea level, giving a static head of 1145 ft. at the nozzles in the power house. Water is carried from



The Jordan River Dam.

the diversion point on the Jordan River to the forebay reservoir in a wooden flume about $5\frac{1}{2}$ miles long, built along the east side of the Jordan River Valley. A small dam in Alligator Creek diverts the water from that creek into a small flume which joins the main flume about a mile below the diversion point on Jordan River. Wye Creek joins the river above the diversion dam. Bear Creek flows into the Jordan River about $3\frac{1}{2}$ miles above the main diversion dam, and the Bear Creek storage dam lies near the headwaters of that creek and about a mile above its junction with the Jordan River.

On account of the variable flow of the Jordan River and its tributaries, storage reservoirs form an essential part of the scheme. Five sites suitable for storage dams have been located, but only two of these dams have been constructed at the present time. These dams are known as Bear Creek dam and Jordan River dam.

The Jordan River dam is a hollow reinforced concrete structure of the Ambursen type, with crest 1268 ft. above sea level. The dam is 891 ft. in length along the crest. A spillway is provided near the east end of the dam with curved crest and rollway apron which enables water overflowing the spillway to fall clear of the toe of the buttresses; the spillway is 305 ft. long with the crest 8 ft. below the top of the dam and provides for a discharge of 23,000 cu. ft. per second. The extreme height of the dam is 126 ft. above the lowest point of the foundation on the centre line. This dam is believed to be the highest dam in Canada, and it is the second highest dam of the Ambursen type so far constructed.

The original power house building completed in 1911 was a concrete structure, in which two units of

4000 kw. capacity were installed with the necessary exciters, low and high tension switches and transformers. On account of the rapidly increasing load on the company's system, the original installation has been added to. The additions necessitated the extension of the power house building to accommodate a new 8000 kw. unit with space for a fourth unit, and an entirely new high tension switchroom for the completed plant behind the power house. The extensions were completed in October, 1914.

The low tension generator and transformer switches are placed on the main floor at the west end of the new portion of the building; these switches are of the H-6 type of the Canadian General Electric Company. The bus bars are carried in concrete cells in the basement, immediately under the low tension switches.

Current at 60,000 volts is conducted from the transformers through the back wall of the generator room in porcelain wall bushings into the high tension switch room. The high tension buses are supported in insulators on the back wall of the room, and the 60,000 volt type A. A. Westinghouse switches are in a line down the center of the room, directly under the disconnecting switches, which are mounted on a structural steel frame. All high tension conductors are of 1 in. copper tubing. Two 60,000 volt lines leave the building through large wall bushings and lead to a steel distributing tower a short distance in the rear of the power house.

The transmission line from Jordan River power house to Victoria Substation is about 37 miles long. For about 15 miles the location follows the shore, then strikes inland to Victoria. The poles are of cedar cut along the line; they vary in height from 50 ft. to 60 ft. and have a minimum diameter at the top of 9 in. The conductor is aluminum cable made up of seven strands of No. 8 wire; two piece 60,000 volt suspension insulators are used throughout the length of the line. Cross



Jordan Power House During Construction.

arms for two circuits are provided, but only one circuit has been installed; the second circuit will be strung in the near future.

The Western Canada Company, Ltd.

The Western Canada Power Company, Ltd., was formed in 1909 for the purpose of supplying power for industrial purposes in Vancouver and the vicinity so as to encourage the establishment of factories, and in sufficient quantity to meet any demand that the growth of Vancouver may develop. They commenced



Interior of Stave Falls Plant, showing Switchboard Gallery.



Stave Falls Plant.

the construction of a 50,000 h.p. power plant in the winter of 1909-1910. The first section of this power house, comprising two units of 9000 kw. capacity each, was completed and power was delivered in Vancouver on January 1, 1912.

The site of the power development is at Stave Falls, about six miles north from the junction of the

Stave and Fraser Rivers at Ruskin, B. C., and thirty-five miles east of the City of Vancouver.

The power plant, as it now stands, consists of a sluice dam 40 ft. high, provided with five sluice ways 22 ft. wide, to take care of the flood discharge; a solid concrete intake dam; two 14 ft. 6 in. steel penstocks with provision for two more; a power house with two 10,000 kw. units and provision for extension for two more, and a tailrace channel 1500 ft. long excavated in the old bed of the river. The foundations for the power house were excavated in solid rock. The total quantity of rock excavation for the penstocks, power house and tailrace amounted to 75,000 cubic yards.

The tailrace canal is 70 ft. wide, and designed to run 10 ft. deep when all four units in the power house are in operation. In addition to the rock excavation for the tailrace, some 75,000 cu. yd. of sand, clay and boulders were excavated by steam shovel.

Just below the power house a small V-shaped weir was built to hold the water to a proper height to seal the draft tubes. At present the flow of the river is rapid from below the foot of the tailrace, but when the lower plant is built, the water will be backed up to this weir.

Western Canadian Power Co., Ltd., Hydraulic Plant Equipment.

Stave Falls 2-13,000 h.p. Francis.

Turbines.
Generators.
2-10,000 k.v.a., 4400 volts

Transformers.
2 banks of 3-3000 kw.

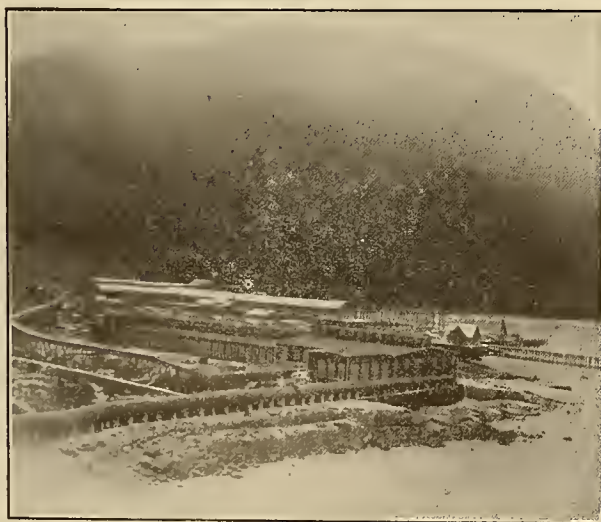
The foundations for the power house are of solid concrete construction, and the superstructure is a combined formation of steel and reinforced concrete. The building is 100 feet wide by 90 ft. long. The turbine and generator room is 75 ft. by 90 ft., and a two-story lean-to 28 ft. wide houses all the high tension and low tension switches. The control switchboard is on a gallery in a lean-to at the end of the building. The power house is now being extended 70 ft. more for the installation of two new units.

The 13,000 h.p. Francis type turbines were built by the Escher Wyss Company of Zurich, Switzerland. Excitation is provided by two 250 kw. 125 volt generators, each driven by its own turbine, and each capable of exciting four machines. Governors and oil pumps were also provided by the Escher Wyss Company, the pumps being driven by individual wheels of the impulse type.

A travelling crane of 70 tons capacity spans the entire main floor, placing the transformers as well as the generators and wheels directly under the crane. The control switchboard is in a gallery at the east end of the building, giving the operator full view of every piece of moving machinery. All switches are solenoid operated, and with the fuses, are located in reinforced concrete cells in a separate lean-to parallel to the main building.

The Ocean Falls Company, Ltd.

The property of the Ocean Falls Company, Ltd., is situated at Cousins Inlet, about 300 miles north of the City of Vancouver. Cheap power for the operation of its pulp and paper manufacturing plant is provided by the Link River project. The total capacity of the turbines at present installed amounts to 11,200 h.p., but provision has been made at the head-works for doubling this capacity at a later date.



The Ocean Falls Plant.

A small storage dam is provided at the lower end of Link Lake, and at a point about 800 ft. from the power house a concrete diversion dam has been installed on the Link River. This dam is provided with an intake section with two 12 ft. diameter openings for pipe line connections controlled by sluice gates. The dam is of gravity section, with a maximum height of 60 ft. above the lowest point of the foundation.

From the dam, the water is conveyed to the power house through one steel pipe line 12 ft. in diameter 776 ft. long. The lower end of the pipe line is parallel to the back wall of the power house; a branch pipe coming off the main pipe line is provided for each water wheel unit. Provision for a duplicate pipe line between the dam and the power house is provided for.

Three hydroelectric units are at present installed; consisting of 600 kw., 3-phase, 60-cycle, 440-volt Westinghouse generators, each driven direct by a turbine of 900 h.p. supplied by James Gordon & Company, operating under a head of 115 ft. A 50 kw. motor generator set supplies power for the electrically driven mono rail system used on the wharves for loading lumber, etc.

The units are controlled by an 8-panel Westinghouse switchboard.

For the operation of the pulp grinders, hydraulic turbines are provided; the grinders are in groups of four, each group being driven by a 1600 h.p. turbine of the Francis type, supplied by Jens Orten-Boving.

Canadian Collieries (Dunsmuir) Ltd.

The Puntledge River, which is the natural outlet of a lake of the same name, discharges into the Gulf of Georgia on the eastern side of Vancouver Island, British Columbia, at a point about 60 miles north of the City of Vancouver. The Canadian Collieries (Dunsmuir) Ltd., which owns and operates a group of coal mines at Union Bay, has developed the power possibilities of this stream, and the several steam plants which were formerly in operation at each of the company's mines, have been superseded by a central hydroelectric power plant with 13,200-volt distribution system, whereby considerable economy in operation has been effected.

The maximum recorded flow of the Puntledge River is 3500 cu. ft. per second, and the minimum is 330 cu. ft. per second. A study of the flow curves available showed that by creating sufficient storage in Puntledge Lake, a constant flow of 800 cu. ft. per second could be maintained.

An impounding dam was built at the outlet of the lake to raise the water 23 ft. above the original lake level and provides useful storage of 132,000 acre-feet.

From the outlets of the storage dam the water flows in the natural bed of the river to the diversion dam about $2\frac{1}{2}$ miles below the lake.

At the diversion dam the water enters a system of canals and flumes 3400 ft. long, in which length there are many sharp curves necessitated by the broken nature of the country. The canal sections occur in solid rock, sand, gravel and clay, and with the exception of some portions in impervious clay, all are lined with concrete. The sections of the canal are connected by wooden flumes which have the same carrying capacity as the canal.

The pipe line intake is a vertical cylindrical chamber of reinforced concrete about 25 ft. in diameter and having a height above the bottom of the outlet opening of about 30 ft.

The elevation of the pipe line intake is 414 ft. above sea level, giving a static head of 350 ft. at the power house.

From the pipe line intake the water is carried in

a wood stave pipe 8 ft. in diameter and 4500 ft. long, to a "Y" structure with two outlets for 72 in. diameter pipes.

The power house is a reinforced concrete structure, built on a rocky site on the river bank. The present building provides space for two generating units and covers an area of 34 ft. by 117 ft., which is approximately half the area of the building contemplated for the ultimate development. The annex section of the power house has been built complete, and space is provided to accommodate all the switching and auxiliary electrical apparatus for the completed plant. This section of the building is three stories high and has a ground area of 18½ ft. by 65½ ft. It is built of reinforced concrete with concrete floors and roof.

There are installed in the power house two Escher Wyss turbines of the reaction type with multiple balanced gates operated by governor. Each unit is provided with a hydraulically operated gate valve in conjunction with the turbine. Under the available head of 350 ft. (static) each turbine is rated at 4700 h.p. at 500 revolutions per minute.

Directly connected to each of the two turbines is a 3-phase, 25-cycle, 3500-kw., 21,200-volt Canadian General Electric generator. To each unit an exciter is directly connected, the capacity of each of which is sufficient for the excitation of the two main units. The generators and outgoing lines are controlled by means of Canadian General Electric H-3 motor operated oil switches from a switchboard also supplied by the Canadian General Electric Company.

At various places on the property, substations are provided in which are installed oil insulated water cooled transformers with a total capacity of 6500 k.v.a., supplied by the Westinghouse Company.

All large motors are supplied with current at 2200 volts; the smaller motors operate at 440 volts. For supplying the latter motors, Westinghouse transformers of 2000 k.v.a. capacity, which step down the voltage from 2200 to 440 volts, are provided. All of the substation equipment was supplied by the Canadian Westinghouse Company.

For winding at the mine shafts and for driving compressors, etc., a number of large motors are provided, the largest of which is 750 h.p. These motors are of the three-phase, 25-cycle, 2200-volt type, and are either of the slip-ring or self-starting synchronous pattern.

The ventilating fans are driven by two 350 h.p. Westinghouse, 3-phase, 25-cycle, 2200-volt slip-ring motors running at 250 revolutions per minute, and are provided with Westinghouse automatic liquid self-starters. When for any reason power is cut off, the automatic liquid self-starters open the motor circuits, and when the power is restored the self-starters automatically connect the primary of the motor to the line: by means of a small motor the resistance in the secondary of the fan motor is gradually reduced, and the fan motor is thus slowly brought up to full speed, when its slip-rings are short circuited.

The cost of the present development is slightly under \$70 per horsepower at the power house switchboard. When the plant is completed to its ultimate capacity, the cost per horsepower will be reduced to about \$60.

(To be continued.)

REPORT ON COLUMBIA RIVER POWER PROJECT.

Appendix C—The Meteorological Conditions Causing the Flood of 1894 and Low Stages in the Columbia River in 1890 and 1912.

BY EDWARD A. BEALS,
District Forecaster, U. S. Weather Bureau, Portland, Ore.

The amount of water in a river is wholly dependent upon rainfall. By rainfall is meant precipitation of every character, whether it be rain, snow, hail, sleet, dew or frost. It would therefore seem as if we could easily determine the run-off of a river if we knew the amount of rainfall within its catchment basin; but such is not the case, owing to the diversified action of water after being deposited on the ground. Some soils are absorbent and some are not; also the absorbent qualities of soils vary from time to time. Some of the rainfall is evaporated, some seeps slowly into the soil and may find an outlet years later in the same or another drainage area, and some may remain frozen for many years, if not centuries.

Within the Columbia River drainage area of 259,000 square miles there are now in operation about 385 rainfall stations, of which about 285 are equipped to record both temperature and rainfall. Most of these stations are in the United States, not more than 35 being located north of the Canadian boundary. If these stations were at equal distances apart, there would be one rainfall station for every 673 square miles and one temperature station for every 909 square miles, which number is inadequate for obtaining an accurate measurement of the precipitation in the Columbia River drainage area. Furthermore, a large proportion of the stations are located in the settled valleys, and only a few are located high up in the mountains, where the precipitation is heaviest.

In discussing the effect of rainfall on stream flow in the Columbia River Valley, the first obstacle, even at the present time, is inadequate information regarding the rainfall. Twenty-five years ago the number of rainfall stations in the Columbia River Valley could almost be counted on the fingers of one hand: there were none in British Columbia, and those in the United States were all located in valleys where the rainfall was light. Fortunately, the temperature and rainfall at a few stations reflect in a general way the conditions over a much larger area, and with the data at hand we can form some idea of the climatic effect on stream flow, which it is proposed to do in the case of the high water in the Columbia River in 1894 and the low water in 1890 and again in 1912.

Flood of 1894.

In 1894 the highest water ever known occurred in the Columbia River and its principal tributaries. From a published Weather Bureau report, entitled "Daily River Stages" (W. B. No. 507), the flood crest at a number of places was as follows:

Bonnors Ferry, Idaho.....	38.0 ft., June,	1894
Northport, Wash.....	53.0 ft., June 7,	1894
Wenatchee, Wash.....	58.0 ft., June 10 to 13,	1894
Kennewick, Wash.....	32.0 ft., June	1894
Wesler, Idaho	26.5 ft., June 5,	1894
Lewiston, Idaho	26.6 ft., June 6,	1894
Riparia, Wash.....	24.7 ft., June 5,	1894
Umatilla, Ore.....	34.5 ft., June 5,	1894
The Dalles, Ore.....	59.6 ft., June 6,	1894
Cascade Locks, Ore.....	40.7 ft., June 6,	1894
Vancouver, Wash.....	34.4 ft., June 7,	1894

By far the largest portion of the water causing this great flood was from melting snow in the moun-

tains and foothills. In a large drainage area like that of the Columbia River there can be a large amount of snow in the mountains with a small resulting annual rise, or a moderate amount of snow and a large flood. If the amount of snow is small, it is almost certain that the ensuing flood will likewise be small, but under favorable conditions even a small amount of snow might cause a serious flood of short duration.

Should the snow in the drainage areas of the different tributaries so melt as to cause the flood waters of each tributary to reach the main stream when at its highest stage, the result would be a disastrous flood of short duration even with a small amount of snow. Fortunately, such a condition never has occurred and probably never will.

The most important tributary of the Columbia River is the Snake River, which discharges about 60 per cent as much water as does the Columbia River above the mouth of the Snake River. Should the flood crest in the Snake River meet the flood crest coming down the Columbia River, we will have a greater flood in the lower stretches of the Columbia River than would be the case if the Snake River flood crest passed into the Columbia River ahead of the Columbia River crest. The Snake River flood crest always passes into the Columbia River ahead of the latter's crest, for the reason that warm weather begins first in the south and does not reach higher altitudes until later in the season. The headwaters of the Snake River are in the Yellowstone Park, while the headwaters of the Columbia River are in British Columbia. Consequently, the snow begins to melt at the headwaters of the Snake River, before it does at the headwaters of the Columbia River.

Sometimes a general warm wave will sweep over the Northern Rocky Mountains, and the snow melts almost as soon in British Columbia as it does in Yellowstone Park, and when these conditions occur the Snake River flood crest is only a few days ahead of the Columbia River flood crest. In 1894 the Snake River crest passed into the Columbia River only three days ahead of the Columbia River crest, and this fact was one of the factors in making the annual rise of 1894 such a memorable one. The average time the Snake River flood crest reaches the Columbia River is May 28th, and the average time the flood crest from the Upper Columbia River reaches the mouth of the Snake River is June 14th, or seventeen days later.

The only stations available for showing the weather conditions prior to and during the flood of 1894 are Baker, Ore., Spokane, Wash., and Boise, Idaho, to which have been added Helena, Mont., and Lander, Wyo., both outside of the drainage area of the Columbia River, but near enough to it to reflect the general conditions. From the records at these stations the departures from normal temperature and rainfall have been computed, and they are shown in Fig. 19, together with the average monthly stages of the Columbia River at Cascade Locks.

From this diagram it can be seen that there was an excess of moisture during the winter of 1892-93 and in the spring of 1893; also that the summer and fall of 1893 were cool. It is therefore likely that there was more hold-over snow in the high mountains in 1893 than usual. In consequence of the cool summer following there was less evaporation, with the result

that the ground water level should have been higher than usual at the beginning of the winter of 1893-94.

In September, October and November, 1893, there was a marked excess in precipitation with temperatures slightly below normal. The December snowfall was light, but the January fall was far greater than usual. The February amount was nearly normal, but in the following month of March it was again heavy, making altogether six out of seven months with pre-

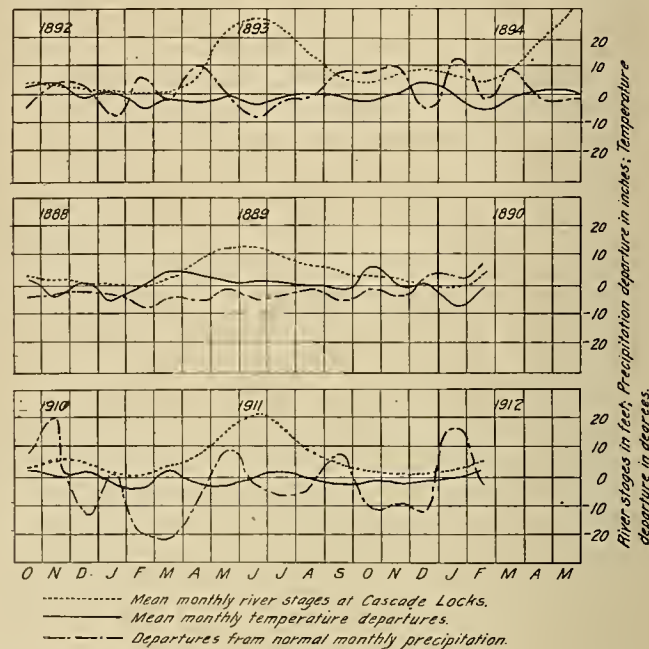


Fig. 19. Meteorological Data.

cipitation nearly normal or above normal. December, with its light fall of snow, was mild, which would cause the snow to pack solidly and make a firm foundation for the heavy deposits in February and March. February, 1894, being very cold, with nearly normal precipitation, all the snow of the preceding months was conserved, together with that which fell in February, so that with the addition of the heavy fall in March the amount in the mountains on April 1st was enormous. The temperatures during March were slightly below normal, but April and May were warm months, and under the influence of the temperatures prevailing at that time the snow quickly melted and the biggest flood in the history of the country occurred. Just how low the river went is not known definitely, but on January 7th a reading was made on the gage below the locks from which a gage height of -3.9 ft. on the Cascade Locks gage was estimated. There is no other record from January 3d to 16th, inclusive, and the stage may at times have gone even lower than this.

Low Water of 1890.

Very low water in the Columbia River nearly, if not always, occurs during periods of low temperature. Should the preceding summer be dry and the ground water which supplies the springs be low, we can expect low water the following winter, and if cold weather sets in for any great length of time, very low stages will occur.

In 1890 these conditions prevailed, and the river at Cascade Locks was below the zero mark for 44 days beginning December 16, 1889, and lasting up to and including January 29, 1890. Just how low the river went is unknown, but on January 17-18 stages

of -2.0 ft. were recorded. There is no record from January 3d to January 16, inclusive, owing to the river being frozen, and it is probable even lower stages prevailed during a portion of that time.

During the period preceding and during this low water we have only two stations available for determining the weather conditions in the Columbia River drainage area above Cascade Locks, viz., Spokane, Wash., and Boise, Idaho. If to these two stations we add Helena, Mont., and Fort Washakia Wyo., just outside the drainage area, we will have four stations that can be used to reflect the general conditions prevailing at the time.

From the records at the foregoing stations the monthly mean temperature and the monthly average rainfall have been determined, and these data, together with the average monthly height of the river at Cascade Locks, are graphically presented in Fig. 19.

The first striking feature of this record is the deficiency in precipitation, which is seen to have been continuous from October, 1888, to November, 1889, or fourteen months altogether. The spring of 1889 was unusually warm, and the temperatures during the summer months were slightly above normal. It was slightly cooler than usual in September and November, but October was a warm month. These conditions would cause the water in all streams within the Columbia River drainage area to be very low up to and including the month of November, 1889. In December the temperatures were nearly normal, and the precipitation was heavier than usual. With normal temperatures in December most of the precipitation above the Cascade Locks would be in the form of snow, and very little would melt; therefore no great amount would run off into the river, and consequently we would expect the main stream to continue to fall, which was just what occurred. Furthermore, owing to the warm spring and summer, evaporation must have been great, and the deficiency in precipitation and high rate of evaporation through these seasons, as well as the deficient precipitation during the preceding winter, could not help but have lowered the level of the ground water, and thus lessened the supply from that source.

At The Dalles, Ore., the average of the daily minimum temperatures in January, 1890, was 15 deg., and from the 4th to the 13th, inclusive, the temperatures ranged from 10 deg. above zero to -12 deg. (below zero), which is very cold weather for that place. The river undoubtedly was frozen to a depth of several inches at Cascade Locks and on up the stream to its source. Under these conditions ice gorges form in the neighborhood of Celilo, as well as at many other places on the main stream and its tributaries. These gorges hold back more or less water, and a very low stage should have been expected above tide water in the lower portion of the river.

Low Water in 1912.

The large number of records used to determine the weather conditions during and preceding the low water of 1912 complicates the situation, and whereas with more records we ought to be able to obtain a clearer insight into the causes of the changes that take place in our rivers, it is more difficult to segregate unimportant data from that which is important in the mass of figures obtained, and irregularities occur that

cannot always be satisfactorily explained. The British Columbia stations were not available in this discussion, and a few stations in the Coast, Southern Oregon and Puget Sound drainage areas were included in the means obtained. It is believed the omission of others will not materially affect the results, as the number in the drainage area of the Columbia River greatly overbalances the others.

The monthly mean temperature from nearly 250 stations and the monthly rainfall from 350 stations altogether, with a graph of the monthly stages of the river at Cascade Locks, are shown in Fig. 19.

From these data it is seen there were slight departures from normal temperature during the winter of 1910-11, with a moderate fall of snow in the early winter and a large deficiency in February and March. This distribution is favorable for slow melting, and the crest of the 1911 annual rise did not reach the Cascade Locks until nearly the middle of June. There was an excess of precipitation during May and September, and a marked deficiency in March and April, during the summer months, and from October to December, inclusive. March and July, 1911, were warm months, while the remaining months that year were cool.

The weather conditions preceding the low water of 1912 would not in themselves indicate a markedly diminished supply of ground water. There was a general tendency in that direction, however, and the deficient rainfall and cool weather from October to December, inclusive, 1911 followed by a period of severe cold in the early part of January, caused a culmination of the drought in the extreme low water of January 5th to 11th. This cold period at The Dalles, Ore., was most severe on January 7th, 8th and 9th. On the 8th the minimum temperature was -11 deg. Heavy ice was running in the river on January 3d and 4th, and it was frozen from January 5th to January 16th, inclusive. On the 8th 31 in. of snow fell, and during the first ten days of the month the total snowfall was nearly 48 inches.

The lowest stage recorded at The Dalles was -1.8 ft. on the 8th and 9th, at which time the river was frozen and covered with a heavy fall of snow. As in the low water of 1890, ice gorges farther up stream must have held back more or less water, so that this low stage is not a good indication of the amount of water in the river above The Dalles at that time. At Cascade Locks the lowest stage was -2.2 on January 10th, and the river was frozen from the 7th to the 11th, inclusive.

In conclusion, it can be seen that high water depends primarily upon the way the snow melts in the mountains at the headwaters of the Columbia River and its tributaries during the spring months, and, secondarily, upon the amount of snow in those mountains. Low water is caused primarily by deficient precipitation for one or more seasons, and secondarily by weather cold enough to freeze the river and allow the formation of ice gorges above the places where measurements are made. A third factor in causing low water is a diminished supply of ground water, and this is due to deficient rainfall for protracted periods covering one or more years.

(To be continued.)

THE NEED FOR A CONSISTENT GENERAL STATE POLICY AS TO PUBLIC UTILITIES.

BY CLYDE B. AITCHISON.

(Concluded.)

So far nothing has been said as to the essentially monopolistic character of the business performed. The best authority now regards the existence of an actual or virtual monopoly as wholly immaterial to the right to supervise the public utility business, and places the right upon other grounds, already suggested. But whether the business is to be one of free competition, or of virtual monopoly, is a basic factor in a complete policy.

If the state is to invite private enterprise to perform its governmental functions, it must deal as fairly with the utility as it expects the utility to deal fairly with it. The investment invited must, to the extent that it is prudently and honestly made, be given such reasonable safeguards that in the long run capital will continue to be invested in such enterprises. It has often been pointed out that public utility investments are of a fixed character; the property stays where it is put, and the owner cannot load it upon the cars and take it elsewhere when market conditions do not suit him in the locality where he has made his investment. In no way can the permanency and attractiveness of the public utility service be impaired more quickly than by unnecessary and useless competition admitted or permitted in an already insufficient field. There is no denying that competition often brings temporary gains to present consumers; and there can be no doubt it is sometimes necessary as a disciplinary measure for a utility which has failed in its duty and for the protection of the public. Likewise there can be no doubt that unnecessary or destructive competition ultimately does the community more harm than it accomplishes temporary benefit; that even for temporary benefits there comes a time of repayment with interest; and that the effects on the state as a whole are deleterious. The most aggravated case of all is where the municipality, through partisan or ill-considered motives, enters into competition—an unregulated free lance—against a regulated, privately owned utility. This situation is met elsewhere, and can be met here by a proper certificate of convenience and necessity law, which will permit the working out of a central, well rounded policy, and simultaneously secure to the local communities permanently all the benefits they now secure temporarily through barbaric competitive warfare. It can be conservatively stated that the rate of return which the utility investor might expect and could lawfully demand in protection of his investment as against a schedule made by a rate regulating body, would be lessened in this state at least one and a quarter per cent per annum. An amount roughly equal to ten per cent of the total existing utility rate schedules is now being paid needlessly, as a premium for the privilege of setting utility corporations on to each other to see which can first be bankrupted. The state is strewn with financial wrecks left after such unnecessary competitive storms have ended, and even the beach combers have nothing to show for their accumulations.

We have indicated that a sound policy would be one which would insure that the enterprise would be

carried on without interruption of service, and would be financially possible at reasonably low rates. The state has a decided interest in the financing of the public utility corporations which engage in its service. Good business requires that an agent should not be entrusted with so important matters unless his own financial affairs are in such shape he will be able to carry the undertaking through. Receivers make poor operators for public utility plants. Some experience with such matters warrants a rather dogmatic statement that financial troubles of public utility corporations usually grow out of their capital issues and funded and other long term indebtedness, rather than form temporary money conditions, insufficient rates, or service emergencies. It is useless to disguise the fact that there has been wild-catting in the financing of some public utility corporations, which is now resulting in calls for settlement which are decidedly embarrassing in certain quarters. Some of the records of the organization and financing of public utility corporations brought to official notice sound more like the deliberations of Wallingford, Daw, and Onion Jones than the transactions of serious and honest business men undertaking the responsibilities of a high public calling. But the present desperate situation of these concerns, facing the necessity for reorganization and the plight of innocent investors shrinking sums paid by them for common stock having absurd nominal par value, and the maledictions they heap on the state for permitting all this, divest such transactions of any element of humor. These things reflect upon the credit of the state. If an outside investor has his choice between utility securities, one of which has been supervised by the state in which the property is located, to insure a fair relationship between nominal capitalization and actual value, and honest methods of accounting and application of the proceeds, and the other of which is in a state where no such safeguards have been thrown around the transaction, in which state will investment be made more readily? In which state will the interest rate expected be the lesser? The questions answer themselves.

Every incentive for consistent business policy calls for the reasonable regulation of the issuance of capitalization and funded debt of utility corporations, for the protection of the credit of the state, in order that the interest rate may be kept at the lowest possible figure, and to insure the carrying out by the utility agency of the public profession which it makes. This policy is being consistently followed as an integral part of the public utility program elsewhere, and at least until such time as the federal government undertakes it, a state which omits these necessary precautions is failing in a plain duty.

The recognition of the public character of the public utility employment and the state-wide responsibilities assumed in the calling raises some questions as to policy in the intercorporate or inter-utility relations of these concerns. The postulate made is that the policy adopted shall be such as eventually will prove of the greatest advantage for the widest possible community. This would require, as sound policy, the avoidance of economic waste both by avoidance of useless duplication of facilities and by requiring the interchange of traffic and service in proper cases. The utili-

ties, as agents of the same principal, owe it the duty of furthering the interests of their principal by co-operation. Here again the distinction between the momentarily advantageous and eventually profitable is to be kept clearly in mind by the utility which is reluctant to declare a truce and act in harmony with its former competitors in the future joint service of the commonwealth.

As details in the program, one requirement of which is the preservation of the utility's service in an unimpaired condition, proper accounting methods and the establishment and proper expenditure of reasonable depreciation and renewal reserves or funds may be mentioned. These requirements have usually been made with more or less vigor by the public service commissions, and are being worked out with some degree of consistency. They are mentioned, therefore, rather than discussed. In like manner may be passed with casual reference the creation of public service commissions in practically all jurisdictions with the primary objects of securing the adequacy of service and reasonableness and equality of rates which the law requires. The policy to be evolved by the states will naturally center around the present activities of the public service commissions. There is need of correlation of the functions of such commissions with those of other tribunals dealing with other phases of the subject; and, in the case of interstate utilities, with the federal commission similar bodies in other states.

It might as well be understood, however, that the work performed by such commissions, to be effective, must be of a highly technical character, covering a wide diversity of fields, and cannot be performed with credit to the state or the commission or with full justice to the utility or its patrons except by the expenditure of sufficient money to procure high grade expert assistance of sufficient quantity to permit prompt attention to matters which require investigation. A state which cannot afford to spend enough to insure thorough, expert work, would far better restrict rather than increase the scope of duties of the commission until its financial conditions warrant paying for what it expects.

A rational and consistent state policy as to public utilities would pay particular attention to the question of taxation, including the general property tax and the various local occupation and other license fees exacted.

Undoubtedly in determining the economic cost of public utility service there must be taken into consideration the repayment by those receiving the service for the special benefits conferred upon them through the medium of the utility corporation. There can be no objection to the imposition of a reasonable tax upon the utility's property, fairly commensurate with the benefits the state confers and the expenses the state is put to in the safeguarding of the property and those engaged in operating it. This would logically include the indirect expenses of the state as well as first cost due to the exercise of the police power. These expenditures should be borne by the utility service, equally with insurance and other comparable items.

It cannot be admitted, however, that the best tax is that which succeeds in plucking the maximum amount of feathers from the goose with the least

amount of squawk. At least, the goose could scarcely be expected to subscribe to such a doctrine.

Generally speaking, no great attention has been paid to the question of public utility taxation in connection with the development of a rounded policy. It has been recognized for a considerable time that the peculiar relation between the utility and the public, whereby the public service corporation is permitted to shift the tax burden onto its consumer directly, and still demand protection and compensation rates for its investment and service, makes it relatively easy to impose tax burdens upon public utility properties. In consequence, taxes have been and are imposed entirely as if, by some legerdemain, the tax money was extracted from the pockets of some invisible, intangible, non-resident and non-resistant stockholder, who was powerless to oppose and absorbed the excessive burden without attempt to retaliate in the way of diminished quality or extent of service, or by increasing rates or withholding reductions in schedules. This manifests itself in the property tax by assessments which exceed the value the property would bear if in private service—always supposing a correct equalization—supposed to be for the intangible franchise or earning power; and in the municipalities we find gross earnings and fixed amount occupation taxes imposed as conditions precedent to the right to serve the public at all. If the assumption which underlies every attempt at the collection of an undue amount from a public service agency were correct, and the excess in fact was absorbed by the utility owner, it might be temporarily to advantage to resort to such methods of raising public moneys, although the ethical situation would not be altered. But anyone who assumes that such unduly burdensome taxation is borne by anyone other than the resident utility patrons and the community as a whole, either in the way of rates maintained higher than they should be, or curtailed service, is very ignorant or purposely uncandid.

On the other hand, it is equally important there be a proper apportionment of these governmental costs to the utility service; otherwise, the general property assumes part of the cost of furnishing the service to a particular class of citizens, or if regulation be imperfect, the returns of the investor are unduly large.

The tax problem is larger than merely getting of revenue for the state, and for its municipal governments. It deserves consideration as a part of the whole policy, because of the close connection between rates and service on the one hand, and the making of the public utility business sufficiently attractive to maintain the investment of private capital therein on the other. Particularly should the problem be divorced from local consideration.

In passing, it may be observed that the patrons of the municipally owned utilities owe a similar duty to the general property owners to contribute their fair share to defray the cost of the special benefits received. Generally there is no account taken of this in municipal operation of its utility plants. The result is a concealed but none the less effectual shifting of these costs from the one who is benefited to a larger class, many of whom are not benefited by the service, and then the costs are apportioned by a rule which has no relationship either to the cost of performing the service or the benefits conferred.

DIESEL ENGINE PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

Care and Operation of Earlier Types of Engines.

[Continued.]

When the engine is running, careful watch must be kept on the pressure of the spray air. The appearance of the exhaust will indicate whether the air is too low or too high. If it is too high, a pound will be heard on the fuel valve and white smoke will appear. If too low, black smoky exhaust will appear. It is always advisable, if possible, to let the circulating water run for ten or fifteen minutes after the engine is shut down so as to cool it off gradually. The tops of the pistons in a Diesel engine naturally become very warm while running under load and when the engine is shut down, if the circulating water is cut off at once, the pistons in a stationary position will heat the water in the cylinder jacket around them so hot that the lubricating oil will run off the pistons and there will be nothing left to lubricate them when the engine is again started. This would naturally add to the loss of compression and sometimes causes trouble in starting. Then again the hot pistons would cause the gummy oil that is around the rings to fry and cook and naturally cause the rings to stick. Also the heat from the piston will heat the wrist pin at this time, which causes the oil to run off of that, and when the engine is started it is some time before lubricating oil can again reach this point.

In stopping the engine, if possible, throw the load off gradually. If it is necessary at any time to shut the engine down quickly in case of accident or for some other reason, the quickest way is to shut off the fuel and let the engine stop or die with the load on.

In nearly all Diesel engines there is a small hole provided somewhere in the exhaust valve cage which allows the engineer to inject a little coal oil on the exhaust valve stem. The reason for this is that with a small load on the engine the exhaust valve stem is liable to become gummed with the unburnt oil. This, of course, greatly depends upon the kind of fuel oil being used. A fuel oil high in asphalt is more liable to cause gumming than oil with a paraffine base. When using an oil with an asphalt base it is always quite necessary to put coal oil in the exhaust valve stems before shutting down. The spray air should never be shut off the engine until it is almost stopped. The first thing to do is to shut off the fuel, which is the life of the engine. As the engine starts to slow down the bleeders on the air compressor should be opened. When the engine is at a standstill close the lubricators on the engine and the compressor and close the valves on the air bottle as tightly as possible.

The care of the valves of a Diesel engine is a very important thing, as the success of the operation depends entirely upon their being kept tight. The writer would advise the owner of a Diesel engine or a prospective purchaser, to always have a number of spare parts on hand, the most essential being one admission valve and one exhaust valve complete. By this is meant the valves and the cages in which they set. In this way on Sunday, if that is the day the engine is to be shut down for a few hours' inspection, the admission valve and exhaust valve can be taken out of one

cylinder and the two valves in perfect condition put in their place. The following week the engineer could see that those taken out were put in condition and ready for the next change. This could be continued, say every three or four weeks, so there never would be a time when it was necessary to shut the engine down to grind valves, and by so doing the valves would always be in good condition. If the engineer tries to grind valves on a Sunday, or any day that might be selected for the two or three hour shut down, he naturally does the work in a hurry, the valves being more or less hot and the work is not done properly. In grinding either the exhaust or admission valve it may be often observed after grinding a few minutes that the valve and seat will appear to be in perfect condition but it is always a good idea to test the seats before putting the valves together. A good way to do that is to wipe the seat of the cage and the valve as clean as possible and then mark the seat crosswise about 1 inch apart all the way around with a lead pencil. Then put the valve in place and give it half a turn. If by so doing all pencil marks are cut off the valve has a perfect seat. If any of the marks are left it is necessary to keep on grinding until they all come off by turning the valve, giving an absolute assurance of a good seat.

Nearly all Diesel engine builders furnish with the engine a number of spare parts, consisting of one fuel needle, one atomizer, one fuel pump plunger, one fuel pump suction valve, one fuel pump discharge valve, one complete set of springs for all valves and one complete set of gaskets. But to have a safe supply of spare parts everything they furnish singly should be brought up to the number of cylinders on the engine. In this way if it is a three-cylinder engine there should be three of each of the parts, while if of four cylinders four of each except gaskets. Of these there cannot be too many, and it is always advisable to have at least a half dozen piston rings on hand. The cylinder heads should be lifted at least once a year, the pistons taken from the engine, the wrist pin taken out and the bearings examined and refitted. All rings should be removed from the piston, the ring grooves and rings thoroughly cleaned and if any of the rings show wear they should be replaced. At such a time during the overhauling of the engine all bearing caps should be lifted and the shaft and bearings examined, as much as possible, then the caps reset and locked.

If the engine is of splash lubrication the lubricating oil should be cleaned out of the crank case at least once in six months. If there is leakage by the rings due to wear or stuck rings, it is necessary to clean the crank case at shorter intervals. The engineer can always judge the condition of the oil in the crank case by its color. Even though the oil might look dark, by taking a small quantity on your finger and going to the sunlight, if you can get a green shade the oil is still good. If the oil shows black in the sunlight it is time to clean the crank case. The proper way of doing this work is to bail out all the oil and water that can be taken from the crank case. It is good practice, at such a time, to start the engine up with the doors off and watch the lost motion or anything that might be loose in the crank case and cannot be seen at any other time, but it is inadvisable to run

the engine longer than five minutes as the crank pins will get hot. After this inspection is finished put in the regular amount of water that would ordinarily be followed by a new supply of lubricating oil, then add three or four pails of fuel oil to each crank pit, put the doors on and start the engine and run it for 15 minutes. It will be found when the doors are taken off that the working parts of the engine are thoroughly washed off, this method cleaning the bearings where it is impossible to wipe out the dirt. It also prevents either the lint from rags or waste that might be used in cleaning remaining in the crank case and finally after running collecting in the lubricating holes of the bearings. The water and oil should then be bailed out and thrown away, the usual amount of water and lubricating oil placed in the case ready for running. Waste should never be used at any time inside of the engine, or in any place where it might fall in while the doors are off.

In the setting of the main bearing caps it is a good idea, in order that the clearance may be known exactly, to use No. 10 fuse wire, placing four pieces across the shaft, one at each end and two near the center, then putting the cap on and pulling down as hard on the nuts as possible so as to allow about .006 clearance, then mark the nuts and bearing with a center punch so that they may be brought back to the same place. After removing the wires build up with metal shims until it is all you can do to pull the nuts down to the marked places. Then your cap will be solid and you know the clearance is correct.

After once going over the engine in this way and resetting caps with thin shims it will be easier to make the adjustments from that on as one can be taken out from each side, the cap pulled down as hard as possible and the engine turned over; if it turns free it is all right to go ahead with another run or until it is necessary to overhaul again.

The admission valve is contained in a cage designed to permit the removal of both valve and seat to allow of easy access for grinding. If the valve should get into bad condition it may be necessary to ream the seat and face the valve. This should rarely be necessary, but if done, great care should be used in maintaining a true and even pressure on both valve and seat at an angle of 45 degrees. Every precaution must be exercised to remove all cuttings or emery and all parts should be thoroughly cleaned. When replacing the admission valve cage into the cylinder head see that all contact surfaces of both the head and cage are well cleaned and that the gasket is in good condition. Tighten the holding down nuts with a wrench only. Do not use a hammer or length of pipe on the wrench and be careful to get the cage down evenly on the joint. After starting the engine watch the valve for evidence of leak, and should there be a sign of one carefully draw up on the nuts. Do not delay doing this or the gasket will rapidly burn at the leak and have to be replaced. A leaky admission cage will cause a serious loss of power.

(To be continued.)

Electric iron ore smelting is a commercial success at Soderfos, Sweden, where a 4500 kw. furnace is employed. With a current consumption of rather more

than 3000 k.v.a., the average production of pig iron is 250 tons weekly, with a consumption of 77 cu. ft. of charcoal and 15½ lb. of electrodes per ton of iron. For three 2200 kw. furnaces at Hayfors 48 men are required, their wages per ton being 94½ cents. These three furnaces cost about \$250,000, of which the buildings, furnaces and transformers cost about one-fourth each respectively.

Polarization of Leclanche cells is not due to hydrogen, as is generally supposed, but to ammonia, which is liberated by the splitting up of the ammonium radical, combining with the water to form ammonium hydroxide, and hence hydroxyl ions by dissociation. These hydroxyl ions bring about polarization. The dissociation of the ammonium hydroxide can be prevented by the addition of excess of ammonium chloride and the polarization thus diminished, but the best method is to add zinc chloride, which gives rise to complex zinc ammonia compounds, thus preventing, to a large extent, the formation of ammonium hydroxide and hence of hydroxyl ions.

The epoch-making inventions of the world have mostly been made by Americans, as is shown in the following list as prepared for the annual report of the Secretary of the Interior:

American Inventions.	Inventor.	Date
Telephone	Bell	1876
Typewriter	Sholes	1878
Cash register	Patterson	1885
Incandescent lamp	Edison	1880
Talking machine.....	Edison	1878
Electric furnace reduction.....	Cowles	1885
Electrolytic alkali production....	Castner	1890
Transparent photograph film....	Eastman	1888
Motion-picture machine.....	Edison	1893
Buttonhole sewing machine.....	Reece	1881
Carborundum	Acheson	1891
Calcium carbide	Willson	1888
Artificial graphite	Acheson	1896
Split-phase induction motor....	Tesla	1887
Air brake	Westinghouse	1869
Electric welding	Thomson	1889
Type-bar casting	Mergenthaler	1885
Chain-stitch shoeseving machine	French & Myers.....	1881
Single-type composing machine.	Lanston	1887
Continuous-process match machine	Beecher	1888
Chrome tanning	Schulz	1884
Disk plows (modern type).....	Hardy	1896
Welt machine	Goodyear	1871
Electric lamp	Brush	1879
Recording adding machine.....	Burroughs	1888
Celluloid	Hyatt	1870
Automatic knot-tying harvester machine	Appleby	1880
Water gas	Lowe	1875
Machine for making barbed wire	Glidden	1875
Rotary converter	Bradley	1887
Automatic car coupler.....	Janney	1873
High-speed steel	Taylor & White.....	1901
Dry-air process for blast furnace	Gayley	1894
Block signals for railways.....	Robinson	1872
Trolley car	Van Depoele & Sprague	1874-1887
Harveyized armor plate.....	Harvey	1891
Foreign Inventions.	Inventor.	Nationality.
Electric steel	Heroult	French
Dynamite	Nobel	Swedish
Artificial alizarine (dye)	Graebe & Lieberman	German
Siphon recorder	Thompson	English
Gas engine, Otto cycle..	Otto	German
Wireless telegraphy....	Marconi	Italian
Smokeless powder	Vielle	French
Diesel oil motor.....	Diesel	German
Centrifugal creamer....	De Laval	Swedish
Manganese steel	Hadfield	English
Electric Transformer....	Gaulard & Gibbs..	English
Cyanide process for extracting metal	Arthur & DeForrest	English
Mantle burner	Welsbach	Austrian
By-product coke oven..	Hoffman	Austrian

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As the old year is thrown on the scrap heap of the ages, obsolete and depreciated, a word of absolute appreciation is fitting. To the West, particularly, nineteen hundred and fifteen has been kind, for it has been a time for making new friends. The attractions of two expositions conjoined with the distractions in Europe to turn the tide of travel to the West. "See America first," to many an American, has acquired a new meaning with the Pacific Coast as the object of the seeing. Most of those who came and saw have been conquered by the desirability of the West as a place to live. Those who were entertained as friends and guests will be doubly welcome as friends and neighbors.

As nineteen fifteen, the exposition year, passes into the past, the West faces a fair future. Its advantages have been advertised, new peoples are preparing to make prosperous homes in its pleasant surroundings, and there is hope of legislative relief from the past onerous restrictions to a natural development of natural resources.

The old year, that is even now lightened of its load as the new year is brought up to synchronism, has been one of getting ready rather than of actual doing, particularly as regards engineering construction. New mines have been opened, new industries started and new plans made for greater production.

The most notable electrical features of the year in the West have been the illumination of the Panama-Pacific International Exposition and the electrification of the Montana division of the St. Paul railroad. These are noteworthy because each is the prototype of the lighting and traction methods of the next few years to come. Already the flood lighting so successfully employed at San Francisco has been applied in other localities and the next decade, also, should witness the electric operation of most of the railroads within transmission distance of a hydroelectric plant.

The revival in mining has brought with it an increased use of electric power for hoisting and milling. Electric irrigation pumping as a current consumer is constantly increasing and the improvements in electric ranges and the energetic sales policy pursued, have combined to threaten to tax the generating capacity of some companies.

Yet there are those who say that "more rapid development of waterpower in the West is mainly prevented by the lack of consumers rather than by the absence of suitable legislation." While the West will welcome more men, its per capita use of hydroelectric power, while the highest in the country, has just started. The more electricity a man uses, the more he wants to use. In Nevada there is being tried out a new process for the electric extraction of nitrogen from the air, which, if successful will double the use of electricity in that state. The latent and wasting water powers of Oregon and Washington are needed to propel the railway locomotives instead of by the wasteful consumption of expensive fuel. More abundant power will cheapen mining costs in Arizona and more intensive application will lighten labor in California.

While the West needs more men it also needs laws which will make it possible to use the water that is now going to waste. This is the promise which the new year is expected to fulfill.

Periods of transition create balance-distributing conditions which urge the necessity for properly letting go the past in order to grasp the present, and thus be prepared for whatever improvement the future may afford. The partial reason for this is that it is difficult to entirely discard old equipment of proven service for the untried new, no matter how brilliant the promise of performance.

So, though "the old order changeth" in lighting, as in other fields, it is not true that it yields place without considerable opposition, to the new. Until they demonstrate their utility or desirability and thus overcome the inertia of past activities and expenditures, innovations will be opposed. To overcome this opposition is to uncover opportunity and makes for business permanence.

In lighting there are economic reasons for customers clinging to things as they are. These, combined with the fear of further progress which shall render obsolete the new things of the now, sometimes makes difficult the proper and complete use of the best equipment available.

To hastily review the remarkable lighting progress of the past few years, both in improved artificial light sources and their equipment, is to excuse somewhat the tendency on the part of the consumer to view the adoption of new ways and methods with alarm or at least with displeasure rather than in that opposite state of mind which the manufacturers of lamps and equipment, jobbers, dealers, contractors and others interested would much rather perceive.

But to put new wine into old bottles can be no more disastrous than the use of the new high efficiency lamps of increased brilliancy in old equipment neither suitable, nor useful for properly redirecting or diffusing the light; esthetically displeasing and dangerous to the eyes. The abortive attempts of the would-be economists and the uninitiated to adapt old equipment to the latest lamps and the use of these also without auxiliary equipment of whatever kind, are an affliction to be seen—or thrust upon you—in whatever direction the eyes may turn.

In this last transitional period which is also a prophecy of the future warning signal of what to avoid, conditions positively dangerous to eyesight have been created. These call for an aggressive educational campaign and sales policy on the part of the whole industry that electric lighting shall not through misuse fall into disrepute and an all-round loss of revenue result.

In certain localities an adverse business situation makes such collective effort in dealing with the customer difficult and these localities show the further need for lighting legislation—such as that which was applied in many states for the amelioration of untoward factory lighting—being now so widened in scope that they may be made applicable to all commercial lighting.

But whether the consumer is induced through education to adopt those measures and make those expenditures in alterations to equipment or wiring calculated to serve his best interests or is enforced so to do through public protective measures, it is self-evident that electric lighting maintain its past or an improved

standard of excellence, whatever the means which must be pursued to that end.

For the present, we must not only endeavor to educate others but ourselves also and be honest as practitioners in applying the knowledge thus obtained. This, in lighting, is the whole duty of the whole industry.

Considerable discussion is current as to how the condition and position of the engineer can be bettered.

Unlike the lawyer and the doctor, the engineering profession seldom comes into direct contact with human beings. Though men are dependent upon engineering structures, upon waterworks, power plants, telephones and electric cars, for many of their necessities and conveniences, they are prone to lose sight of the engineer as an indispensable factor in their design, construction and operation. Consequently it behooves the engineer to get into closer touch with the people as well as to broaden his field of activities.

The financial field is one which a number of engineers have entered with success. It is likewise one which offers opportunities for many other engineers who feel the limitations of work of a strictly technical character. The financing of public utilities can well be undertaken by engineers because of their more or less technical character.

The engineer can speak as one with authority concerning public utilities. This inspires confidence, the first requisite in the financial world. The best methods of construction, the probable costs and the possible market are subjects about which the financial man now consults the engineer, who, like, John Alden, would do well to speak for himself.

This speaking for oneself is an art which most engineers have failed to cultivate. This lack of oral expression arises, in part, from a praiseworthy modesty, but in part also, is a deficiency in the engineer's education. It is a rare engineer who is not afraid of the sound of his own voice. Let every engineer, therefore, learn how to talk as well as how to do, for talking moves men's minds mightily.

The engineer should also learn the elements of corporate finance. He should be informed about securities, the varieties of stocks and bonds, their obligations and their privileges. A balance sheet should be as clear to him as a logarithmic equation. There is nothing from which an engineer can profit more than a post-graduate course in such business subjects as these. Financial reading is an important part of every engineer's education.

These suggestions, while of value to every engineer, are particularly essential for observance by the man who would employ his engineering knowledge and ability in the service of the investor. The business of financing public utility and other securities is legitimate and remunerative. The engineer can do much to further advance its standing and, in so doing advance his own fortunes. Meanwhile, also, the general public will be taught to appreciate the need for greater service from the engineer.

PERSONALS

W. R. Lyall of the D. & W. Fuse Company, Providence, R. I., is a recent visitor at San Francisco.

Geo. C. Campbell, manager Truckee River General Electric Company, and Mrs. Campbell are spending the holidays at San Francisco.

A. S. Lindstrom, of the Thordenson Electric Company of Chicago, has opened a branch office at San Francisco in the Rialto Building.

Carl E. Heise, San Francisco manager of the Westinghouse Electric & Mfg. Company, has returned from Los Angeles and San Diego.

B. J. Klein, western manager of the Bristol Instrument Company, has decided to open an office at San Francisco in the Rialto Building in the near future.

E. J. Kingsley, Southern California representative of the Federal Sign System (Electric), has returned from San Francisco to his headquarters at Los Angeles.

H. P. Munger of the Hughes Electric Heating Company, Chicago, has returned to San Francisco after a short business trip to Salt Lake City and the Northwest.

A. J. Myers, Pacific Coast manager of the Wagner Electric Company, has returned to San Francisco after a successful business trip throughout Southern California.

C. C. Hillis, manager of the Electric Appliance Company at San Francisco, received the sad news this week of the death of his father, Edward Hillis, of Columbus, Ohio.

S. K. Colby, assistant general sales manager of the Aluminum Company of America, has just returned to his office at New York after a two months' visit on the Pacific Coast.

A. S. Armstrong, sales agent representing R. J. Davis of the Century Company, will visit the towns throughout the Sacramento and San Joaquin Valleys about the first of January.

Wm. G. Stearns, formerly of the Portland office of the Standard Underground Cable Company, is now at the San Francisco office of that company as chief salesman in the district.

Paul A. Shilton, representing R. J. Davis, Pacific Coast manager of the Century Electric Company in Los Angeles, has returned to this city after an extended trip throughout the Southwest.

R. E. Bailey, power salesman in the Salt Lake division of the Utah Power & Light Company, has been transferred to the sales department of the company's general office at headquarters in Salt Lake City.

W. S. Berry, sales manager of the Western Electric Company at San Francisco, has returned to San Francisco after visiting their offices at Portland and Seattle, where he is much pleased with the improved conditions.

M. F. Steel, representative of the Benjamin Electric Manufacturing Company, has returned to San Francisco after a very successful business trip to the Northwest. He is expecting to leave for Arizona in the near future.

K. G. Dunn, vice-president of Hunt, Mirk & Co., has recovered sufficiently from an automobile accident at San Diego last month so that he can be moved to San Francisco, where every prospect indicates an early resumption of activities.

F. W. Wilson of the San Francisco office of the Standard Underground Cable Company, will be located after January 1, 1916, at Salt Lake City. The company is opening a sub-office at that point, and Mr. Wilson will be in charge as district sales agent.

H. S. Wells, superintendent of residence district sales in the Salt Lake division of the Utah Power & Light Company, has returned to Portland, Oregon, for a couple of weeks, where he was called to testify in a law suit in which the Pacific Power & Light Company, with which he was formerly connected as salesmanager, is involved.

T. W. Ransom will give up his position as consulting mechanical engineer to the board of public works of the City and County of San Francisco, on January 1, 1916, and will return to his former practice as a consulting engineer with offices at 1104 Merchants' Exchange Building, San Francisco.

A. Emery Wishon, assistant general manager of the San Joaquin Light & Power Corporation of Fresno, Cal., spent a week in Salt Lake City recently. While there he investigated electrical developments in that field, particularly with reference to the application of electricity to cooking and baking. Mr. Wishon expresses himself as favorably impressed with progress which the Utah Power & Light Company has made in the installation of electric ranges in apartment houses and electric bake ovens in restaurants and bakeries. He spent considerable time interviewing their customers and quite generally received unqualifiedly favorable comments.

Paul M. Lincoln, whose connection with the Westinghouse Companies in their operating and engineering activities dates back for over 23 years, as of January 1, 1916, becomes associated with the sales organization of the Westinghouse Electric & Manufacturing Company with the title of commercial engineer. Mr. Lincoln is well known in engineering circles through his active work in the American Institute of Electrical Engineers, of which he is a past president. He is a well-known writer on technical subjects, and has also been identified with educational work for some time, filling the chair of professor of electrical engineering of the University of Pittsburgh. Mr. Lincoln was graduated from the Ohio State University in 1892.

W. D'A. Ryan, chief of illumination for the Panama-Pacific International Exposition, stopped off in Salt Lake City, December 17, while on his way from San Francisco to Chicago, where he had been called in connection with plans for some special lighting for Christmas. While in Salt Lake City he appeared before the city commission and explained to them details for the special lighting system on Main street, which he designed. The system consists of a special ornamental post designed to fit over and conceal the regular trolley pole. Each post carries three 6.6 amp. inverted luminous arc lamps. The standards will be spaced approximately 100 ft. apart on each side of the street for a distance of 4000 ft. on Main street. The commission, after listening to Mr. Ryan, approved the plans as submitted and instructed the recorder to prepare an advertisement for notice of intention to make the improvement accordingly.

Bayard W. Mendenhall, sales superintendent of the Salt Lake division of the Utah Power & Light Company, has tendered his resignation, effective December 31, and will thereafter engage in business for himself. Two years ago Mr. Mendenhall organized the Electric Specialty Company, which makes a line of electrically heated chick and bacteriological incubators, and he will now devote his entire time to the interests of the company. Mr. Mendenhall entered the employ of the Utah Light & Railway Company in the fall of 1905, as power salesman, and has been with that company and its successor continuously since, except for one year spent at Ely, Nevada, as manager of the Ely Light & Power Company. Since May, 1908, he has held the position of commercial agent for the Utah Light & Railway Company and as sales superintendent for its successor, the Utah Power & Light Company. Mr. Mendenhall graduated in electrical engineering from the Massachusetts Institute of Technology of Boston in 1902. The next three years he spent in the organization of Stone & Webster of Boston.

PIERSON, ROEDING & COMPANY CHANGES.

H. R. Noack, president of Pierson, Roeding & Company, announces the resignation of Thomas Finigan as vice-president of the company. On January 1st Mr. Finigan will take charge of the interests of the American Brake Shoe & Foundry Company as Pacific Coast manager, with offices at 301-303 Call Building, San Francisco. H. S. Whiting of Pittsburgh, has been elected vice-president to succeed Mr. Finigan. Mr. Whiting has already taken up his residence in San Francisco, and is in active charge of his new office.

In line with the new policy of Pierson, Roeding & Company, as published in the December 11th issue of the Journal, two important changes in agencies have occurred.

After five years of successful and satisfactory association with the Electric Storage Battery Company of Philadelphia, it has been decided to discontinue this arrangement, and after January 1st, the Electric Storage Battery Company will be located in their own sales office at 739-745 Rialto Building, in charge of George R. Murphy, until this time manager of Pierson, Roeding & Company's storage battery department.

On January 1st the long standing relations with the R. D. Nuttall Company will also change, and hereafter the Nuttall Company's business will be handled by the Westinghouse Electric & Manufacturing Company at its various offices on the Pacific Coast.

The J. G. Brill Company of Philadelphia, Pa., also announce that their successful and very satisfactory association with Pierson, Roeding & Company has for years postponed having their own offices and their own representatives on the coast. As circumstances point to the present time as being best suited for making the change, it was decided to institute the new procedure December 1st and extend their own sales organization to cover the Pacific Coast territory, with offices at 907 Monadnock Building, San Francisco, under the management of Mr. F. A. Richards, who has had charge of the car and truck department of Messrs. Pierson, Roeding & Company since 1909.

NINTH ANNUAL REPORT PUBLIC SERVICE COMMISSION OF OREGON.

The Public Service Commission of Oregon in its ninth annual report reviews the work of the past year.

The total number of formal complaints filed during the year 1915 was 130, compared with 141 in 1914. Ninety-one of the new matters were in the railroad division, and 39 were utility matters. New informal railroad complaints were 263 in number, against 345 in 1914, while informal utility complaints increased from 177 in 1914 to 204 in 1915.

Of informal utility matters, 229 were handled, 204 of these being new, 25 pending at date of last report. Informal adjustment was accomplished in 167, 9 were transferred to

in 50. Of the new informal utility matters, 169 were filed by individuals, corporations or associations, and 35 were taken up on the commission's own motion.

Formal utility complaints show 20 dealings with rates and 22 with service, certain of the complaints covering both rates and service. Twenty-nine related to telephone utilities, 4 electric or gas, and 6 water. Twenty-seven formal hearings were held, 34 complaints were closed, and 18 are pending.

Among the important cases disposed of during the year, the following may be mentioned:

City of Bend v. Bend Water, Light & Power Co., Case No. UF-108, involving electric lighting and water rates at Bend; Campbell v. Hood River Gas & Electric Co., Case No. UF-82, electric rates in Hood River and Hood River Valley; La Grande Commercial Club v. Eastern Oregon Light & Power Co., Case No. UF-75, involving lighting rates in numerous cities in the Grande Ronde Valley; In re Western Telephone Co., Case No. UF-142, telephone rates at Woodburn; Tualatin Valley Transportation Association v. Oregon Electric Ry. Co., Case No. UF-290, suburban rates out of Portland; Wright-Dickinson Hotel Co. v. Pacific Telephone & Telegraph Co., Case No. UF-22, physical connection of competing telephone systems; and In re rates, charges and regulations of the Pacific Telephone & Telegraph Co., Case No. UF-117, as to customers' deposits, cancellation charges and other telephone practices.

Hearings have been concluded on the question of the value of the property of the Portland Railway, Light & Power Company. Upon this subject, testimony covering in excess of three thousand pages was received, and 140 separate exhibits were offered. This case is now submitted for decision. Testimony as to the value of the properties of the California-Oregon Power Company has also been taken, but the case is not fully submitted.

The following statement shows the mileage of lines owned and operated of the various electric railroads within Oregon as to June 30, 1915:

Commercial Roads— Electric.	Mileage Owned.		Mileage Operated.	
	Main Line.	Branches and Spurs.	Main Line.	Branches and Spurs.
Kenton Traction Co.....	2.90		3.00	
Oregon Electric Ry. Co....	122.30	35.02	122.42	37.49
Portland Ry., Lt. & P. Co.	76.26		76.26	
Portland & Troutdale El..	1.50		1.50	
United Railways Co.....	18.64	11.81	18.64	12.60
Walla Walla Val. Ry. Co..	5.97		5.97	
Willamette Val. Southern.	31.90		31.90	
Total	259.47	46.83	259.69	50.09

The fixed capital as at June 30, 1915, operating revenue, operating expenses, net operating revenues, uncollectable revenues, taxes paid in Oregon, and operating income or loss, from July 1, 1914 to June 30, 1915, of the various gas, telegraph, telephone, water, and joint utilities, are set out in the following table:

	Electric Utilities.	Gas Utilities.	Telegraph Utilities.	Telephone Utilities.	Water Utilities.	†Joint Operations.
Fixed capital, June 30, 1915....	\$4,964,941.28	\$12,706,894.76	1,109,692.08	\$17,243,636.36	\$3,166,331.72	\$123,889,207.01
Operating revenues.....	3,965,212.91	1,453,242.48	175,416.90	3,017,213.35	350,099.25	
*Operating expenses	1,677,832.80	672,747.13	172,236.26	2,182,799.60	196,266.96	243,219.22
Net operating revenue or deficit	2,287,380.11	780,495.35	3,180.64	834,413.75	153,832.29	
Uncollectable operating revenues	3,531.71	7,529.21	1,185.30	22,987.68	820.15	31,555.80
Taxes	39,151.66	101,833.30	9,262.79	161,283.90	18,219.81	755,016.80
Operating income	2,244,696.74	671,127.84	7,267.45	650,142.17	134,792.33	
Operating loss						

*Operating expenses do not include taxes or interest.

†Covers items of joint utility operations incapable of segregation between states or electric, gas, telephone and water utilities.

other docket positions, 5 were discontinued because plaintiffs were disinclined to pursue them further, 13 were dismissed as not well founded and 35 are pending.

Electric rates for light or power were involved in 28 informal utility matters, electric service in 17, gas rates or service in 30, water rates or service in 8, street railway fare or service in 2, telephone rates in 33, telephone service in 61, telegraph rates or service in 2, hazardous wiring conditions

The reports of the utilities indicate considerable rebuilding of lines and replacement of equipment, in addition to extensions into new territory.

During the year July 1, 1914, to June 30, 1915, extensions, additions and betterments, as evidenced by the reports of the various utilities, have been made within the state of Oregon as follows: Electric, \$953,472; gas, \$455,414; telegraph, \$19,800; telephone, \$1,216,724; water, \$84,562; total, \$2,729,972.

LOS ANGELES EDISON CONDEMNATION HEARING.

In accordance with the understanding that "it is not the function of the commission to determine whether the city can by condemnation take a part of a franchise held or exercised by the company and leave the remainder of the franchises in effect," as previously noted in this journal, the California Railroad Commission resumed its hearings of the Los Angeles Edison condemnation proceedings on December 13th, after the city had filed an amended application showing what franchise rights were desired.

The hearings will continue for several weeks. Commissioner Edgerton, representing the commission, is hearing the testimony. The Southern California Edison Company is represented by Attorneys H. H. Trowbridge and Peter F. Dunne and the city by Special Counsel W. B. Mathews, City Attorney Albert Lee Stephens and William B. Himrod.

The just compensation claimed by the company is \$22,850,000. The six items comprising this total are: Severance damage, \$11,000,000; going concern, \$4,500,000; physical property \$4,500,000; Los Angeles Station No. 3, \$1,000,000; bond discount and expense, \$350,000; reconstructing transmission lines, \$1,500,000.

Of the foregoing total of \$22,850,000, \$9,850,000 represents the value of the Los Angeles distributing property and business. This amount would go to the company's bondholders and stockholders.

The balance of the amount claimed as just compensation, \$13,000,000 is damage to the rest of the system, which would in no way benefit the company's stockholders or bondholders, but would be held by the trustee for the bondholders, to be drawn upon from time to time to make up loss in earnings, rebuilding property and finally for investment in new properties to provide additional earnings to make up the loss of earnings in Los Angeles city. This damage is caused by the separation of the Los Angeles business from the outside business, resulting in a decrease in efficiency, as the Los Angeles business has its maximum demand in the winter, while the outside business has its maximum demand in the summer. It may be justly termed "amount of the economic waste involved in the present proceedings."

The case for the company was opened by H. H. Trowbridge, who stated that the company owns a large interconnected electric generating transmitting and distributing system, having a considerable number of hydroelectric plants in different parts of Southern California, and several steam plants; that this system was created by the acquisition from time to time of a large number of smaller companies and systems, and by additions and extensions from time to time by the company itself and by its predecessors of interest. "We will show that the system is operated as a unit in its entirety; that the City of Los Angeles is the center of the company's distribution of electric current and that the company derives approximately 45 per cent of its gross and net revenue from its business within the City of Los Angeles; that the company's properties for the generation and transmission of electric current are used partly for supplying Los Angeles and partly for supplying the company's customers outside of Los Angeles; that of its so-called general investment, something upwards of \$5,000,000 is required for supplying electric current to this company's consumers within the City of Los Angeles; that upon the severance of the Los Angeles distributing system from the balance of this company's property, this company will be left with this proportion of its properties for the generation and transmission of electric current for which the company will have no use until such time, if that time ever comes, when the maximum demand upon the company's generating system after severance is the same as the demand prior to severance.

"One of our claims for compensation in this case will be the damage which this company will suffer by reason of the severance of its Los Angeles distributing system from the

balance of its interconnected unit property. To show this element of damage, we will introduce testimony showing the results to this company and to its business caused by such severance. We will introduce testimony upon this subject from a number of witnesses who will approach the subject from somewhat different angles and will not all arrive at the same result in dollars and cents, but the amount of this severance damage which we will claim as part of our just compensation in this case will be established by these witnesses at sums ranging from ten to twelve millions of dollars.

"A second item of just compensation which we will claim in this case is the value to this company of its business in the City of Los Angeles which will be taken from it in this proceeding. We will introduce testimony from several witnesses as to what is the value to this company of its Los Angeles business. These various witnesses will likewise approach the question of placing a value upon this item of property in somewhat different manners and will arrive at somewhat different results. They will likewise not all give the same name to this element of property. One witness, Prof. Adams, will describe this property as 'the value of the property as organized and used in excess of the investment cost of the property, or the physical value of the physical value of the property.' Other witnesses will refer to this element of property as 'going concern value.' However, they will all mean the same property, viz: the value to this company of its developed and organized business in the City of Los Angeles of which it will be deprived in this proceeding. The value placed by different witnesses upon this element of property will range from \$4,619,000 to \$4,360,000.

"Another element of compensation which this company will claim in this case will be the value of its physical property in Los Angeles sought to be taken in this proceeding. We will show by testimony in this case that the cost of this physical property, determined by the historical method is \$5,320,437.92. We will show the present physical condition of the property and its present value, or, as the term is sometimes used, 'depreciated value.'

"We will also claim as an element of compensation in this case, an amount equal to the discount and expense actually incurred by this company in selling its bonds and securities to secure the funds with which it acquired and constructed this Los Angeles distributing system which will be taken from it. This bond discount and expense will be shown by this company from its books; the amount thereof will be shown to be approximately \$350,000.

"We will also claim as an element of compensation in this case the expense which this company will necessarily incur in reconstructing and rebuilding its lines around Los Angeles to continue its service after severance, such rebuilding being made necessary by this company's franchises to occupy the streets of Los Angeles with any part of its electric system being taken or destroyed by this proceeding. The amount of this expense to which this company will be subjected we will show by engineers who have made estimates thereof to be approximately \$1,500,000. We will also claim as an element of damage in this case the loss which this company will sustain by reason of being deprived entirely of its use of its Los Angeles Station No. 3. We will show by the testimony of the company's accountants that this Station No. 3 cost \$1,267,755.18, that by reason of the taking of this company's property and franchises making it no longer possible to use this station, will have a present existing value to this company of \$124,344. The difference between these two amounts less proper and appropriate depreciation, we will claim as our damage in the case of Station No. 3.

B. F. Pearson on Physical Properties.

Mr. B. F. Pearson, general superintendent of the Southern California Edison Company, was the first witness called by the company.

Mr. Pearson gave a general outline of the company's gen-

erating, transmission and distributing systems, beginning with the power plant located in the City of Los Angeles in 1896, having a capacity of 500 kilowatts, ending with the company's present generating capacity of 86,000 kilowatts, comprising seven hydroelectric stations and three steam plants.

At the present time the company's 75,000-volt transmission system has a total length of 214 miles; 10,000-volt lines, 730 miles; 2200-volt lines 1800 miles. Total number of consumers at the present time, 108,435, giving a connected load of 141,766 horsepower with a peak load for the year 1915 of approximately 56,000 kilowatts, whereas the peak load at the end of the year 1897 was only 220 kilowatts.

All data relative to the development of the company's property was brought up in cross examination, including the effect on the transmission system should all the company's property in the City of Los Angeles be severed.

The answer being, the company could not operate except the eastern division up to the capacity of the hydroelectric stations in San Bernardino county, total 8500 kilowatts. It was also brought out in testimony that had Los Angeles not been considered, the steam plant would have been located on Newport Bay, with transmission line intersecting Santa Ana-Orange, with a terminus at Chino, thus bringing the steam plant to the nearest center of the greatest load districts.

R. H. Ballard Explains Many Phases.

R. H. Ballard, secretary and assistant general manager of Southern California Edison Company, during his direct examination which covered Tuesday and part of Wednesday, testified to the following:

The present company, Southern California Edison Company, started in Los Angeles in 1896 as the Westside Light-ing Company as a small steam plant distributing system.

The company was enlarged and its name changed in 1898 to Edison Electric Company and in 1909 to Southern California Edison Company. In the meantime many properties outside of the city had been purchased and the company's affairs extended generally throughout Southern California.

The principal properties purchased were: Santa Ana Gas & Electric Company, Southern California Power Company, Pasadena Electric Light & Power Company, Redlands Electric Light & Power Company, California Power Company, United Electric, Gas & Power Company, Lytle Creek Power Company.

Large contracts were made to supply power to the two cement plants in Riverside and Colton and in 1907 the company began furnishing service to the Los Angeles Pacific Railway, which is now part of the Pacific Electric system, embracing the lines running to Santa Monica and Hollywood sections.

The gross earnings of the company in 1896 were only \$3,333 for the year while the earnings in 1915 for its electric department were \$4,427,000.

The increase in kilowatt hour sales during almost the entire period has been much greater than the increase in earnings as rates have been constantly reduced, the average rate in 1915 for the entire system in Southern California being only 40 per cent of the rate in 1905; in other words, a reduction of 50 per cent in ten years.

The maximum load on the company's stations in 1904 was about 10,000 kilowatts, while in 1915 it was nearly 56,000 kilowatts.

Testifying further as to the effect of cutting out the Los Angeles business from the balance of the system, Mr. Ballard showed that the gross earnings would be reduced from \$4,400,000 to \$2,300,000—a reduction of nearly 50 per cent—and that while it is estimated the maximum load on the stations would be recovered in eight years, in the eighth year 1923 the earnings would still be \$700,000 a year less than they were before

Los Angeles was taken out of the system, due to decreased efficiency.

Likewise the number of kilowatt hours sold during 1915, over 208,000,000, would be reduced by the loss of the Los Angeles business to 110,000,000. During the next eight years they would increase to 178,000,000, being approximately 30,000,000 kilowatt hours less than before Los Angeles was taken away.

It was shown that the combination of the Los Angeles and outside business was particularly advantageous from the standpoint of efficiency and economy as the maximum demand for current in Los Angeles comes in the winter time while the maximum demand for current outside of Los Angeles comes in the summer time.

The same plants which furnish the large winter demand on Broadway at Christmas time are used in the summer time for pumping water for irrigation in the districts outside of Los Angeles, resulting in a lower cost both inside and outside the city which is reflected in the company's rates to consumers.

In other words, there is a great diversity between the city and the outside.

Referring to rates in the City of Los Angeles, Mr. Ballard showed that in 1905 the maximum rate for residence service was 15c per kilowatt hour; in 1908, the rate was 9c per kilowatt hour—a reduction of 6 cents in three years; in 1911, it was 7c per kilowatt hour, and in 1915, 5½c per kilowatt hour.

Outside of Los Angeles, the rate in the districts served by the largest company purchased by the Edison Company in 1904 was 20c per kilowatt hour, and at the present time it is 7c per kilowatt hour.

He referred to the rates in other cities in the United States, showing the comparison with the 5½c rate in Los Angeles city.

D. M. Trott, statistician, took the stand for company and qualified as having had fifteen years' experience in general accounting. He was examined by Mr. Dunne as to cost of property.

Mr. Ballard's cross-examination was taken up by Special Counsel Mathews and continued until late in the afternoon of the 16th, when Dr. Hoxie was placed on the stand by the company.

Dr. Hoxie in his testimony, among other things, produced sixteen charts showing the divisions of load carried by the company in its different districts expressed in kilowatts of demand upon stations; kilowatt hours sold to consumers, based upon a study of each day's record of each of the thirteen districts of the company in the past year.

The first chart showed graphically that were the Los Angeles business taken out of the system, the remaining business would be entirely disarranged by the fact that the center of load would be transferred from Los Angeles to Colton and the cost of furnishing service to all of the outside districts would be increased.

Many of the small communities who have accepted the service of the company at the general rates based upon the unit cost of the company operating as a complete, unified system, would be made unprofitable to the company unless compensated for as part of severance damage.

It was shown that by operating all of the districts of the company as one system, the individual maximum demands of each district were at different times, resulting in a maximum load on the company's generating system of 55,880 kilowatts; whereas, if each district of the company were operating separately, the sum of the maximum demands of these districts would have been over 75,000 kilowatts, necessitating an additional investment in generation and transmission property to provide the extra 20,000 kilowatts, representing an added cost of over \$4,000,000.

FUNCTIONS OF MUNICIPAL INSPECTION BUREAUS.

BY ARTHUR KEMPSTON.

(This paper gives excellent suggestions as to how the electrical inspector can assist the electrical contractor. It was read before a meeting of the California Association of Electrical Inspectors. The author is inspector with the San Francisco Department of Electricity.—The Editor.)

Inspection of electrical work installed in the premises of its citizens is one of the newer functions of municipal government. It has existed in San Francisco only since 1900. Its beginnings were simple and the effort was at first only to provide an inspector when the owner of property requested an inspection.

Electricity was then considered an exceedingly dangerous thing. A sort of condensed fire, ready at all times to escape its confining wires and burn up the building. Users demanded an expert examination of the installation, oftentimes believing that unless watched, the contractor would "skin the job" in his effort to make a greater profit.

Unfortunately, the same feeling exists today somewhat modified, perhaps. It influences to a considerable extent our vision of just what inspection is.

Inspectors are practical men who have worked at the various branches of the electrical business and they know costs and methods. They can readily see the saving in costs which can be had by lax methods of work or the use of poor material. From the very nature of things, as existing today, the inspector becomes a Sherlock Holmes, always seeking faults and defects. He is not an educator, however, and therein lies the serious error of our present attitude. Because of the continual search for defects and the sleuthing done, an inspector's view is narrowed and his conception of duties contracted until in time he fairly believes that his mission is solely to prevent contractors "beating the game."

It is certainly time to revise our methods of handling the entire problem of electrical inspection. We should abandon the idea of standing between the contractors and the public and substitute in its place a new attitude. We should become an institution disseminating the latest, best and most economical, methods of doing electrical work.

An inspection bureau can enforce standards of work and material through the powers conferred upon it by the municipal government. It can determine what constitutes a satisfactory method of installation; what materials can be used and in what places; it can decree that certain methods of installation may be used only in certain classes of buildings. It can require that contractors be registered for purposes of control. That jobs be reported before any work is started. That installations be left uncovered until inspected. That no electric current be used until a final inspection and certification be made. That fees may be collected for its services.

The possession of these duties and powers make the inspection bureau an ideal institution to meet, recognize and correct the evils existing in business of installing electric work.

The contractor of today cannot rightly afford to trade on a belief that with good luck he can get by the inspector with poor work. He has too much at stake. The inspection bureau with its powers may revoke the contractor's right to do electrical work and the publication of such revocation would put the derelict contractor, with all his investment, out of business.

While these extreme measures have heretofore been used very little, the time has come when a more radical stand must be taken with regard to poor work. Contractors should be required to supervise their work more closely. At present many contractors make no pretense of visiting their jobs but depend on the inspector to locate faulty work. This is en-

tirely wrong. Contractors should be required to supervise their work and not depend on the inspector acting as a sort of unofficial foreman for each job.

While it has been the practice in some cities to require an examination of wiremen to determine their knowledge of the business, that has never been necessary in San Francisco. The workers are, almost without exception, competent. There is so much keen competition between contractors that none can afford to hire any but excellent mechanics who know the rules and understand their application.

To enforce a high standard of work is therefore a matter entirely between the inspection bureau and the contractors. The worker can and will produce the grade of work directed by his employer.

The general public should be educated to the fact that electrical work contains an actual hazard to life and property. All should be made to realize that only when installed properly by skilled mechanics is the use of electricity safe. That putting in an extra light, heating device or a motor constitutes a distinct danger to the building and its occupants unless it is properly provided for in the wiring of the building.

As in all matters where so many and varied interests are represented, it is necessary to have a final tribunal, whose decisions, reached after consideration of the question in its largest aspect, shall be capable of enforcement. It is in this duty that an inspection bureau can demonstrate its worth and value. The greatest effort should be made of course to procure the safest installation possible. This must not be carried to such an extreme though that the amount of labor required or the cost of material is unreasonably excessive. There is a cost above which property owners will not go for the installation of electrical work and that must not be exceeded. To do so would result in the use of gas or other means to the detriment of the electrical industry.

The successful inspection bureau will hereafter promulgate its rules and requirements after consultation and conference with all the interests involved. After such consideration it will be in a position to expect and receive full support from all parties in the enforcement of rules.

To that end it is necessary after a policy has been determined by the inspection bureau, that it shall be clearly set forth so that all those interested, contractors, wiremen and inspectors, may have an exact and uniform understanding. Thereafter any deviation would necessarily be deliberate and intentional and result in serious consequences to the guilty person.

It is very essential that inspectors, particularly, be familiar with the exact requirements and the reasons therefor; that regardless of their private opinions on any question, all enforcement of rules would be absolutely uniform.

Swift and sure exposure should be given any contractor who deliberately violates the rules or permits it to be done by his employees. Let it be known that there is no room in the business for law-breakers and there will be little of it done.

Finally keep everlastingly busy on publicity, for the general public. Educate the average citizen so that he would telephone the police if he had knowledge of unreported or improper electrical work being done. Look upon it as you would any other violation of law.

If the public will not have poor work because of the danger, your legitimate contractor will have all the work and at a fair price.

Your inspection bureau will no longer be composed of disciples of Sherlock Holmes but of men who, having the opportunity to study the big electrical problems of today, will be able to sit in on their consideration. I am sure it will be much more to our liking.



NEWS NOTES



FINANCIAL.

SALT LAKE CITY, UTAH.—The Electric Bond & Share Company is offering an allotment of their 7 per cent cumulative preferred stock of the Utah Power & Light Company to intermountain investors through the Harrold R. Smoot Securities Company of Salt Lake City. The outstanding shares of this stock, amounting to \$3,000,000, were recently purchased by the Electric Bond & Share Company from the Utah Securities Corporation. This is the first time any of the securities of the Utah Power & Light Company, except bonds, have been offered locally to the company's patrons, according to Mr. Smoot. He further states that the stock is first preferred, both as to assets and dividends, and the statement of the company for the 12 months ending October 31, 1915, shows that earnings applicable to dividends on the total amount of preferred stock outstanding is more than three times the annual dividend requirements. The Utah Power & Light Company, in addition to the properties operated in its own name, owns all of the capital stock of the Utah Light & Traction Company and all of the stock and bonds of the Western Colorado Power Company, except directors' shares in both companies.

ILLUMINATION.

WENDELL, IDAHO.—Great Shoshone & Twin Falls Water Power Company has been given a contract to install a new city lighting system.

BAKERSFIELD, CAL.—C. B. Colby has been granted a franchise to lay pipes for the purpose of supplying gas to the inhabitants of Kern county, for light, heat and power.

SEATTLE, WASH.—Bids will be received by the office of the Depot Quartermaster, Fort Keogh, Mont., until January 15th, for furnishing and installing an electric lighting system.

BELLINGHAM, WASH.—The city council has passed a resolution instructing the Puget Sound Traction, Light & Power Company to install some 450 tungsten lights in Bellingham.

SPOKANE, WASH.—The city council has accepted the bid of the Washington Water Power Company for the installation of an ornamental lighting system on Trent avenue, at \$27,000.

BOISE, IDAHO.—An application has been made by Wm. D. Wilcox of Chicago for permission to construct a gas plant in the city of Idaho Falls, Idaho. Mr. Wilcox plans to construct a plant by June 1, 1916.

RIVERSIDE, CAL.—A new arrangement has been made whereby the installation of the ornamental lighting system on East Side, is taken over from the City Electric Supply by the City Electric Light Department.

SANTA BARBARA, CAL.—The Santa Barbara branch of the Southern California Edison Gas & Electric Company is planning on duplicating the present gas plant and expects to expend \$50,000 late in 1916 or 1917.

MOSCOW, IDAHO.—The county board has granted a franchise to A. V. Dunkle of Kendrick to utilize the public highways for the purpose of installing an electric light system and transmission lines between Kendrick and Troy.

SACRAMENTO, CAL.—C. W. McKillip, district manager of the Pacific Gas & Electric Company, announced that the company has authorized the expenditure of \$30,000 in Oak Park, to be used in laying gas pipe ends in that section of the city.

PASADENA, CAL.—Two bids for an automatic motor operated induction feeder regulator for the municipal lighting department, from the General Electric Company, \$1350, and

the Westinghouse Electric Company, \$1400, were opened and referred to the city commission.

WEISER, IDAHO.—A certificate of public convenience has been issued to the Weiser Oil & Gas Company authorizing it to proceed to construct a gas plant and mains to supply this city with natural gas from a well near town. The plant must be ready for operation in 18 months.

LOS ANGELES, CAL.—The city council has adopted a resolution authorizing the board of public works to enter contract with the Los Angeles Gas & Electric Company for furnishing current and maintaining arc lights for street lighting in the city, and with the Pacific Light & Power Corporation, for lighting streets in Hollywood district.

RICHLAND, ORE.—It is stated that three different firms have been figuring on a franchise for electric lights and power in Richland. The Oxbow people are figuring on the cost of running their wires to Cornucopia, Pine and Eagle Valleys. A Portland concern is negotiating for a power site near Richland and local parties have a plan in mind whereby electricity for light and power can be generated in conjunction with a water system for Richland and New Bridge.

HOOD RIVER, ORE.—Flood water of the Hood River on December 21 flooded portions of the plant of the Oregon Lumber Company, at Dee, swept away a section of the wagon bridge connecting the city with the East Side trunk road, destroyed a \$2500 fish ladder over the dam of the Pacific Power & Light Company, a short distance up the stream; temporarily put the plants of the Hood River Gas & Electric Company out of business and threatened the bridge of the Mount Hood Railway line.

TRANSMISSION.

NAPA, CAL.—The board of supervisors has adopted an ordinance granting to John N. Mount permission to erect and operate in Napa county towers and other superstructures for conducting electricity.

WINNEMUCCA, NEV.—The Winnemucca Mountain Mining Company is preparing to install a power line from the plant of the Winnemucca Water & Light Company to transmit electric power to the pumping station and thence to the mill, which is also to be run by electricity.

ALBUQUERQUE, N. M.—A. G. Hilberg says eastern capitalists whom he represents have decided to back the White Canyon project. This was stated before a meeting of citizens at the Commercial Club. The idea is to generate power cheaper than present plants can make it.

EUREKA, CAL.—In order that power may be supplied to the Marysville Dredging Company which is to engage in a big gold dredging project, 2½ miles west of Junction City, the Western States Gas & Electric Company's hydroelectric plant which supplies electric power to this city, is to be greatly increased in capacity.

PROSSER, WASH.—The preliminary survey for a dam on the Yakima River for a municipal power plant has been made. Estimates of the cost of the system and the petition will be presented to the city council in January. Should the council approve the plans and call a special election to vote on the bonds the entire plant would likely be built next summer.

TRANSPORTATION.

BERKELEY, CAL.—The city council has refused the petition of the San Francisco-Oakland Terminal Railways to be allowed to abandon that portion of the traction line on Dwight way, east of Shattuck avenue.

FRESNO, CAL.—J. J. Mahoney has announced that the Fresno Interurban Railway Company would extend its line to

Clovis after the first of the year with a spur track to Melvin and would also build a boulevard from Fresno avenue to Clovis along private right of way.

BOISE, IDAHO.—A preliminary survey is being made by the Twin Falls Electric Railroad Company of the route to Castleford with a view of constructing the line as early as possible. The line will extend through Clover City. The road will be about 20 miles long.

OAKLAND, CAL.—Negotiations which may mean the extension of the Key System's Twenty-second street line into the Piedmont hills, opening up the entire region to direct connection with the city, are being made between local capitalists and property owners and the San Francisco-Oakland Terminal Railways. It is anticipated that in a short time a definite arrangement will be completed.

TELEPHONE AND TELEGRAPH.

CHEHALIS, WASH.—The telephone business at Toledo has been sold to George Blair, to take possession January 1st.

HAVRE, MONT.—Hingham Telephone Company, incorporated for \$10,000, will install and operate a telephone system in Hingham.

NORTH YAKIMA, WASH.—Joe Herke of lower Tarpico has purchased the Tarpico telephone property and system, estimated to be worth \$4000. It is understood that Mr. Herke intends to make repairs in the system and will continue to operate.

SAN FRANCISCO, CAL.—Two telephone and telegraph cables between the Ferry Building and Goat Island, containing fifty wires, were severed a few days ago. It is supposed it was caused by some vessel dragging its anchor in the heavy ebb tide that was running.

PRESCOTT, ARIZ.—District Manager R. M. Buehler of the Mountain States Telephone & Telegraph Company, states that work to the amount of \$40,000 will be done on the Prescott telephone system. New Poles and wires will be put in place and it is expected that work will begin in the near future.

WATERWORKS.

RIDGEFIELD, WASH.—The city is receiving bids for the construction of the water system for which \$11,000 in bonds were voted, bids to be opened January 5th.

OLYMPIA, WASH.—Bonds in the sum of \$110,000 have been voted by the citizens of Olympia to take over and operate as a municipal proposition the plant of the local water company.

FALLS CITY, ORE.—The water board has been instructed by the city council to begin work on the water extension to Teal Creek as the work must begin within a certain time to hold their rights.

GOLDFIELD, NEV.—The citizens of Lovelock will soon decide whether they wish to bond the town by special election for the sum of \$90,000 in order to build a water system, or continue to operate under the present system.

COLVILLE, WASH.—An estimate of the city water by D. H. Sawyer, hydraulic engineer, indicates that there is not sufficient water for proper fire protection, and the authorities have under consideration three available water heads for a new system.

MILWAUKEE, ORE.—The contract for furnishing material and construction for the distribution system of the Milwaukee municipal water plant according to plans prepared by City Engineer Morris has been awarded to Giebisich & Joplin at \$22,542.

RIVERSIDE, CAL.—Plans are made to get a water supply system installed and engineers are at work. A well is being sunk near Gage Canal, and two reservoirs are to be built, one on the first knoll, above the main buildings, for supplemental irrigation purposes, the other for domestic use. The main building is to cost \$100,000.

BANDON, ORE.—Bids for the bonds to refund the \$40,000 in outstanding warrants and to renew the water system within the city have been accepted by the council. The Western Bond & Mortgage Company of Portland purchased the bonds.

SANTA MONICA, CAL.—By a margin of 33 votes the electors of Santa Monica refused to bond themselves to the extent of \$712,000 for the purpose of buying out the three water companies and organizing a municipal water system.

TRADE NOTES.

On January 1, 1916, the name Holophane Works of General Electric Company was changed to Ivanhoe-Regent Works of General Electric Company. This change was made necessary by the expiration, on that date of the contract through which the General Electric Company possessed exclusive right to manufacture and sell Holophane prismatic glass. The General Electric Company will continue to manufacture and sell Regent glass and Ivanhoe metal reflectors; and although its right to handle Holophane prismatic is no longer an exclusive one, it will continue to furnish this line also. In its organization the Ivanhoe-Regent Works of General Electric Company is in every respect the same as that hitherto known by the Holophane Works of General Electric Company.

A most unusual and acceptable holiday gift has just been made by the Southern Sierras Power Company in the form of a life insurance policy upon the life of each of its several hundred employees—each policy being for the sum of one thousand dollars. These policies are issued by the Equitable Life Assurance Society of the United States, and the premium upon each policy will be paid and the policies kept in force at the sole expense of the power company and without cost to the employee. Coincident with the announcement of this generous gift. The Southern Sierras Power Company and its associate companies operating in California and Nevada, have established a plan by which the employees of these companies will, from the beginning of the new year, maintain a hospital or sick benefit fund for the care and treatment of employees who from time to time shall suffer illness or personal injury not sustained by accident arising out of and in the course of their employment. This means that the benefits to be had by employees from the use of this fund are entirely separate from the benefits conferred by the Workman's Insurance and Safety Act of California and the Nevada Industrial Insurance Act. To maintain this fund a nominal monthly contribution is made by each employee, (depending upon the amount of monthly salary and in no case exceeding one dollar), and this contribution entitles each regular employee to receive medical and surgical treatment, and hospital care if necessary, including medicines (other than patent or proprietary), in case of sickness or injury; the amount in each case being limited to two hundred and fifty dollars. The creation of this fund is for the sole use and benefit of the employees, and the custody and administration of the fund will be entirely separate from the business of the company, but the company will co-operate by supplying its facilities and the services of its officers to look after the general details of administration.

The board of education of Salt Lake City, Utah, has placed an order with the Utah Power & Light Company for electrical equipment for the domestic science departments of three of the city's graded public schools. The equipment of these departments will be exclusively electric and will consist of 24 Hughes No. 10 hot-plates provided with three heat control and 1100 watt units and two No. 74 General Electric Company's electric ovens for each school. The order includes a special ten gallon soup boiler, the walls of which are insulated and which is heated by a 4½ kw. immersion type heater. This kettle will be used in preparing soup for the light lunch which is served to pupils wishing it and for which a nominal charge is made. If this kettle proves to be entirely successful it is expected by the company that many more will be used in the schools for the same purposes.

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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VOL. XXXVI No. 2

SAN FRANCISCO, JANUARY 8, 1916

PER COPY, 25 CENTS

BRITISH COLUMBIA HYDROELECTRIC DEVELOPMENTS

DIESEL ENGINE PRACTICE.

BY, J. E. MEGSON AND H. S. JONES

REPORT ON COLUMBIA RIVER POWER PROJECT.

BY L. F. HARZA.

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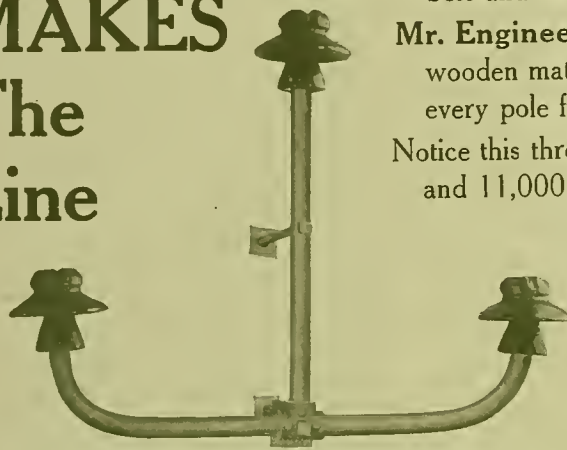
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JOURNAL OF ELECTRICITY

POWER AND GAS

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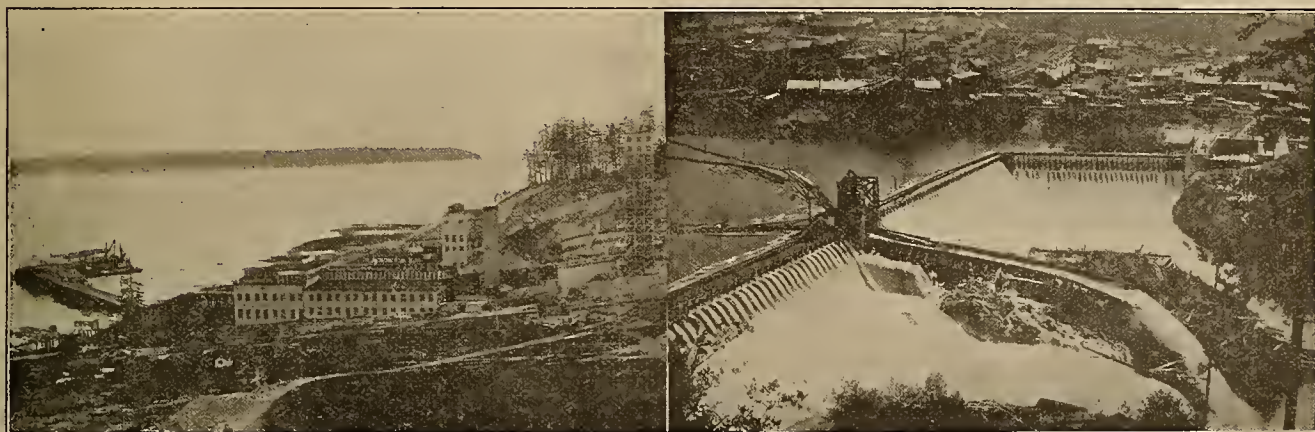


VOLUME XXXVI

SAN FRANCISCO, JANUARY 8, 1916

NUMBER 2

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Powell River Development, showing Paper Mills, Dam and Intake.

BRITISH COLUMBIA HYDROELECTRIC DEVELOPMENTS

(Concluded.)

The Powell River Company, Ltd.

The situation of Powell Lake is particularly favorable for the development of a waterpower scheme. The lake is situated close to the sea coast; its original elevation before the construction of the works of the Powell River Company, Ltd., was 246 ft. above sea level; the area of the lake at this elevation is 65 square miles.

The Powell River Company, Ltd., completed the installation of a pulp mill plant at Powell River in 1911. The minimum flow of Powell River was insufficient for the power requirements of this plant, but by the construction of a concrete dam, the spillway of which is 270 ft. above sea level, sufficient storage was obtained.

A log sluice way is provided in the dam for the passage of logs over the dam, and guide booms to this sluice way are provided on the upstream side of the dam.

From the dam, water is conveyed to the turbines in the power house by means of three pipe lines. One of these pipe lines is of wood stave construction, the other two being of riveted steel.

The power house equipment consists of two 1875 k.v.a., 3-phase, 50-cycle, 600-volt Canadian General Electric generators, each direct driven at a speed of 375 r.p.m. by an Allis-Chalmers-Bullock turbine of 3000 h.p., and one 2500 k.v.a., 3-phase, 50-cycle, 600-volt. Canadian General Electric generator direct

driven by a Platt turbine of 3500 h.p. This unit also runs at a speed of 375 revolutions per minute.

In addition to these hydroelectric units, turbines are used for driving the grinders. There are two sets of seven pulp grinders each driven by a pair of Allis-Chalmers turbines, the capacity of each of which is 1800 h.p. Two Platt turbines, each of 3600 h.p. are provided for driving other two groups of grinders, each of which is made up of five machines.

The Granby Consolidated Mining, Smelting & Power Company, Ltd.

The mining and smelting of copper is one of the principal industries of the Province of British Columbia. In 1894, the industry was practically non-existent; today more than 60 per cent of the copper exported from the Dominion is mined in British Columbia. The growth of the industry has been greatly assisted by cheap power supplied by the development of the water power resources of the Province.

The Granby Consolidated Mining, Smelting & Power Company, Ltd., has recently completed the hydroelectric development of Falls Creek to provide cheap power for the operation of its new copper mining and smelting plant at Anyox, B. C.

Storage is accomplished by a rock filled dam which was constructed with the crest at a maximum height of 115 ft. above the bed of the stream. In the dam, an opening 72 in. in diameter controlled by a sluice gate is provided, to which is connected a 72 in. wood

stave pipe 5817 ft. in length, the first 150 ft. of which is in tunnel. This wood stave pipe is under a maximum static head of 298 ft.; an open standpipe 12 in. in diameter is provided 4000 ft. from the intake. A steel pipe line 72 in. in diameter and about 120 ft. long provided with the necessary branches, connects the lower



Exterior of Granby Power House.

end of the wood stave pipe line with the water wheels in the power house. The working head at the power house is 375 ft.

The power house is a steel frame structure with brick curtain walls built on concrete foundations; it is 180 feet long and 50 ft. wide, and contains five machines direct driven by water wheels for supplying air at various pressures for this operation of the mine and smelter, together with water wheel driven electrical units.

The electrical equipment consists of two 938 k.v.a., 3-phase, 60-cycle, 2200-volt Westinghouse generators running at 400 revolutions per minute. Each unit is provided with two water wheel runners which are directly overhung upon the main drive shaft which is extended at either end beyond the bearings for this purpose. At the present time, either of the two generators is of sufficient capacity for the entire electrical load, so that one of the units may be shut down for repairs without interrupting the electrical service. For the excitation of the generators, two 50-kw., 125-volt, 850 revolutions per minute, Westinghouse exciter sets are provided.

For supplying power to the electric locomotives used for haulage, and for other direct current motors, two Westinghouse motor generator sets are provided; each of these consists of a 440 h.p., 2200-volt, 3-phase, 60-cycle induction motor direct connected to a 300 kw., 550-volt interpole direct current generator running at 850 revolutions per minute.

Two 42-ton Baldwin-Westinghouse electric locomotives are used for hauling ore from the mine to the smelter, and for hauling freight from the wharf to the plant; each of these locomotives is provided with four motors aggregating 336 h.p., and has a starting tractive effort of 28,000 lb.

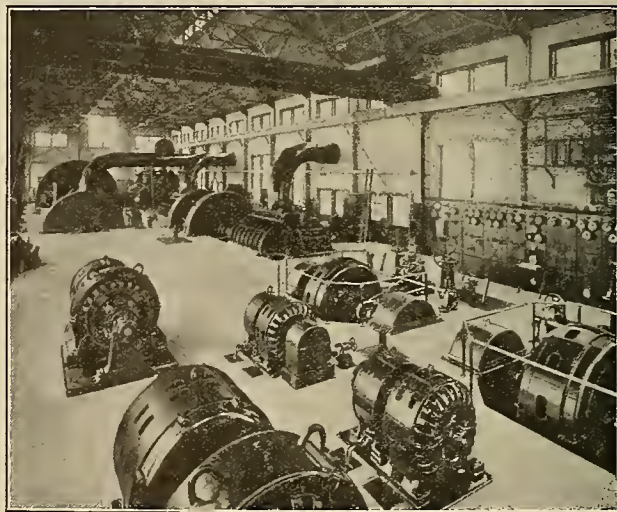
For smelter charge service three 12-ton Baldwin-Westinghouse electric locomotives are used, and four 6-ton locomotives are used for mine haulage.

Alternating current is transmitted to the mine at 2200 volts; the motors on the crushers, and all other large motors are operated from the 2200 volt circuit. The small motors operate at 220 volts.

A 16-panel switchboard is provided in the power house for controlling the generators and the various power circuits; this switchboard, together with the rest of the electrical apparatus, was supplied by the Canadian Westinghouse Company.

The air supply for the main blast furnace and the smelter is supplied by three Connorsville positive blowers, each of which has a capacity for delivering 40,000 cubic feet of free air per minute against a pressure of 32 ounces and operating at a speed of 115 revolutions per minute. Each of these blowers is operated by means of a direct connected Pelton Doble water wheel, 14 ft. in diameter of 625 h. p. normal rating and with a maximum capacity of 775 h.p.

The air required for blowing the Bessemer converters used in the refining of the copper matte at the smelter is provided by a Nordberg variable capacity two-stage water wheel driven blowing engine having a capacity of 12,000 cubic feet of free air per minute under a maximum pressure of 18 lb. per sq. in. and operating at a speed of 75 revolutions per minute. This blowing engine has directly mounted upon its crank shaft, a Pelton Doble water wheel 25 ft. in diameter; this water wheel, in addition to supplying power for driving the blowing engine, furnishes the necessary



Interior of Granby Power House.

flywheel effect to insure smooth operation. The blowing engine is of the reciprocating type and the maximum capacity of the water wheel is 1400 h.p.

For supplying compressed air for the operation of tools at the mine and elsewhere on the property, a Nordberg two-stage air compressor of the reciprocating type is provided; this compressor has a capacity for delivering 4000 cu. ft. of free air per minute at a pressure of 100 lb. per sq. in. and operating at a normal speed of 84 revolutions per minute. This compressor is direct driven by a Pelton Doble water wheel 16 ft. in diameter and designed for an output of 800 h.p. The water wheel runner also provides the necessary flywheel effect.

Kootenay River Development of the City of Nelson.

At Upper Bonnington Falls on the Kootenay River the City of Nelson has installed a hydroelectric power plant which provides light and power for the city and for mining purposes in the surrounding district.

The installation consists of one 750 k.v.a. and one 1000 k.v.a., Allis-Chalmers, 3-phase generators, each driven direct by one 2000 h.p. Allis-Chalmers turbine; the speed regulation is controlled by an Allis-Chalmers oil pressure governor. The head available at the turbines varies from 40 ft. to 60 ft. depending on the stage of the river.

Current is transmitted at 12,000 volts from the power house to Nelson, a distance of 10 miles, over a 2 circuit transmission line; these circuits consist of stranded aluminum cable and are carried on cedar poles.

Barriere River Development of the City of Kamloops.

The City of Kamloops, situated at the junction of the North and South Thompson Rivers, has recently completed the first portion of the hydroelectric de-



Barriere Hydroelectric Generating Station.

velopment of the Barriere River, a tributary of the North Thompson River, to provide cheap light and power for the city, and to encourage settlement in the valley of the North Thompson, where the land is suitable for extensive farming provided cheap power for pumping water for irrigation is available.

To provide the necessary storage a dam was built at the outlet of Barriere Lake; from this point water is conveyed to the forebay through a flume 18,000 ft. in length; from this forebay, which is fitted with sluice gates and provided with a spillway, the water is conducted through pipe lines to the power house, which is situated on the north bank of the Barriere River.

The equipment in the power house consists of the Francis turbines manufactured by the Platt Iron Works, and operating under a head of 190 ft. each of which drives a 750 k.v.a. generator of the 3-phase, 60-cycle type which generate current at 2300 volts.

The necessary high and low tension switching equipment is provided in the power house, together with transformers which step up the voltage to 44,000 volts, at which voltage it is transmitted over a transmission line about 40 miles in length to the City of Kamloops; the voltage is transformed down at a substation which forms portion of the auxiliary steam turbine plant building. This steam plant has recently been completed and is intended for emergency purposes only.

The pumping plant for the city water system is also housed in this building. All of the electrical equipment was supplied by the Canadian Westinghouse Company.

The power house has been constructed of sufficient size for the accommodation of two additional units which will be added to as the load increases. The ultimate capacity of the development is 20,000 h.p.

The cost of the initial hydroelectric installation is about \$140 per h.p.; the installation of further 4000 h.p. will reduce the average cost per horsepower to \$90; it is estimated that when the ultimate development is carried out the average cost per horsepower will be reduced to \$80.

The Hedley Gold Mining Company.

The Hedley Gold Mining Company's hydroelectric developments on the Similkameen River provide light and power for the operation of motors at the mines, and for compressors, crushers, stamps, vanners, pumps and various other machines in the stamp mill and cyanide plant where the gold ore is treated; direct current is also provided for electric locomotives. There are two separate power houses in connection with this development.

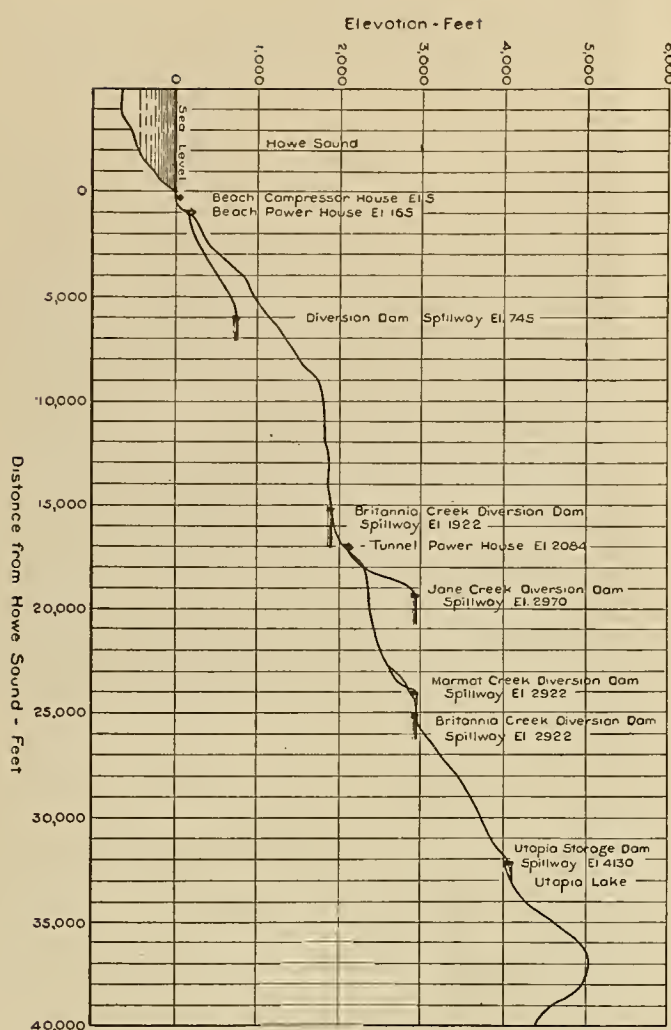
Water for Plant No. 1 is diverted from the Similkameen River by means of a diversion dam formed of stop-logs supported by concrete piers. From the diversion dam, the water is conveyed through 16,000 ft. of flume 9 ft. wide and 7 ft. deep to a forebay, thence through a steel pipe line 8 ft. in diameter to the power house. The static head of the power house is 67 ft.

The equipment consists of one 1250 k.v.a. Canadian Westinghouse 3-phase, 60-cycle, 6600-volt, 400 revolutions per minute, generator (with direct connected 25 kw. exciter) coupled to a 2100 h.p. S. Morgan Smith turbine of the Francis type; standard generator and exciter switchboard panels are provided. Current is transmitted at 6600 volts to the mill $3\frac{1}{2}$ miles distant, where the voltage is stepped down to 2200 volts to enable the two plants to be run in parallel.

Plant No. 2 operates under a head of 412 ft. About 3 miles from Hedley, a dam is constructed which diverts water to a flume about 4 ft. wide and 4 ft. deep and about 13,000 ft. in length to a forebay; from this point, the water is taken to the power house through a steel pipe line 20 inches in diameter to a 550 h.p. Doble water wheel driving a direct Canadian Westinghouse 400 k.v.a., 3-phase, 60 cycle, 2200 volt, generator at a speed of 150 revolutions per minute. A second 20-inch pipe line supplies water to a Knight water wheel driving a Canadian Ingersoll-Rand air compressor of capacity 3000 cu. ft. of free air per minute.

The Britannia Mining and Smelting Company, Ltd.

The property of the Britannia Mining & Smelting Company is situated at Britannia Beach on the east shore of Howe Sound about 28 miles from the City of Vancouver, B. C. To provide light and power for the operation of the haulage and compressed air systems at the mine, and for the motors and lighting at the reduction mill and throughout the camp, a hydroelectric system has been developed comprising a compressor plant built on the foreshore of Howe Sound, 5 ft. above sea level, and two hydroelectric generating stations, named the Beach Power House and the Tun-



Profile of Water Power Development Britannia Mining & Smelting Co., Ltd.

nel Power House, and situated 155 ft. and 2050 ft. above sea level, respectively. The water power available on the property has now been developed nearly to its ultimate capacity. It has, therefore, been found necessary to install one 500 k.v.a. steam turbine unit, and the installation of one 2000 k.v.a. steam turbine unit is now in progress.

The Tunnel Power House is situated about three miles from the Beach Power House at elevation 2050. The power house is a frame building 40 ft. wide and 83 ft. long, and the equipment is as follows: One 200 kw., 3-phase, 60-cycle, 900 r.p.m., 6600-volt, Allis-Chalmers generator driven direct by one 330 h.p. Pelton Doble water wheel. For excitation purposes, one $6\frac{1}{2}$ kw., 125-volt exciter is belted to the unit. One 100 kw., 3-phase, 60-cycle, 900 r.p.m., 6600-volt, Allis-Chalmers generator, driven direct by one 130 h.p. Pelton Doble water wheel. For excitation purposes, one $6\frac{1}{2}$ kw., 125-volt exciter is belted to the unit. One 40 kw. Westinghouse d.c. generator, 675 r.p.m., generating current at 250 volts, direct driven by one 60 h.p. Pelton Doble water wheel, for trolley traction purposes. One air compressor, capacity 700 cubic feet per minute, speed 120 r.p.m., belt driven by one Pelton Doble water wheel of 125 h.p. One air compressor, capacity 1100 cubic feet per minute, speed 180 r.p.m., belt driven by one 200 h.p. Henry water wheel.

The Beach power house is a frame building 30 ft.

wide and 81 ft. long, built on concrete foundations, the elevation of the floor being 155 ft. above sea level. The power house was built at this elevation in order that some of the water from the tailrace might be available for use in the reduction mill, the new section of which is immediately in front of the power house. The water, on emerging from the tailrace of the tunnel power house, enters a 24 in. wood stave pipe line 1800 ft. in length, through which the tail water is conveyed to a point in the bed of Britannia Creek, where a diverting dam is situated; from this intake, water is conveyed with the upper end of a 12 in. "extra heavy" lap welded steel pipe 7900 ft. long. The static head on this pipe line at the Beach Power house is 1765 ft. The following machines in the Beach power house are supplied with water from this pipe line:

Two 200 kw., 3-phase, 60-cycle, 600 r.p.m., 6600 volts, Westinghouse generators driven direct by 330 h.p. Pelton water wheels. To each of these machines is belted a 17 kw., 250-volt exciter.

One 200 kw., 3-phase, 60-cycle, 600 r.p.m. 6600-volt Allis-Chalmers generator, driven direct by one 330 h.p. Pelton water wheel. To this machine is belted one $6\frac{1}{2}$ kw., 125-volt exciter.

In connection with the Beach power house, a second independent pipe line has been installed. The intake is on a unnamed stream, the spillway of the diverting dam being at elevation 750. The water is conveyed from this point to the Beach power house through 18 in. wood stave pipe and 15 in. "extra heavy" lap welded steel pipe, the combined length of which is about 3000 ft. Water is supplied by this pipe line to one Pelton Doble water wheel driving direct one 150 kw., 250-volt, d.c. Crocker-Wheeler generator. Coupled to this unit is a 150 h.p., 220-volt induction motor. This motor will be used to drive the generator, should the water supply become insufficient for the entire plant.

The Tunnel power house and the Beach power house are connected by a wood pole single circuit transmission line, consisting of three No. 2 copper wires, and the generators of the two plants are run in parallel. This transmission line is extended to Britannia Mine at elevation 3500, with No. 6 wire, and to the Beach compressor house with No. 2 wire. At Britannia Mine, four 50 k.v.a., 6600/220-volt oil insulated, self cooled transformers are installed to provide current at 220 volts for induction motors operating crushers, and for two motor generator sets of 40 and 45 kw. capacity, which provide d.c. current at 250 volts for trolley traction purposes. Two 50 k.v.a. 6600/400-volt transformers are provided for the operation of an electric hoist. Pole type transformers of a total capacity of 25 kw. are installed at the mine for lighting.

Within the Beach compressor house are installed 6 150 k.v.a., 6600/220-volt oil insulated self-cooled transformers to provide current at 220 volts for the operation of motors in the reduction mill, machine shop, etc., and for all a.c. power required at the Beach Camp. In addition, pole type transformers are installed throughout the camp for lighting purposes.

The total capacity of induction motors connected to the system amounts to 1268 h.p., and transformers

aggregating 1847 k.v.a. are installed. Mining is carried on with three 8-hour shifts, and the reduction mill is operated continuously; the load factor is very nearly 100 per cent. A very complete telephone system is provided.

City of Prince Rupert.

The City of Prince Rupert has undertaken the development of Woodworth Lake water for power purposes, in conjunction with the extension of the water supply.

Woodworth Lake is situated about 7 miles from Prince Rupert, and has an area of 500 acres; the mean runoff available for the city's use at the present time is 75 cu. ft. per second; additional water records aggregating 10,000 horsepower have been secured for future extensions. To utilize the runoff from Woodworth Lake watershed, a storage dam at Woodworth Lake, 35 ft. in height was built. A suitable power house was found about 7500 ft. from the Lake, giving a head of 330 ft. at the power house.

The initial installation consists of one 1125 k.v.a. 3-phase, 60-cycle, 4400 volts Canadian General Electric generator driven at a speed of 514 revolutions per minute by a water wheel of 1650 h.p. capacity. The requisite flywheel effect is provided by a cast steel flywheel weighing 8000 lb., and a governor operated by oil pressure ensures close regulation. For excitation purposes, a 15 kw. direct current generator connected to the main unit is provided. The voltage is regulated by a Tirrill regulator. The generator and outgoing line are controlled from a 3-panel switchboard.

Water is supplied to the unit from Woodworth Lake through a pipe line 45 in. in diameter and 7800 ft. long. This pipe line is partly used for water supply purposes.

Energy is transmitted to the city over a single circuit wood pole transmission line.

Work was commenced in January, 1914, and the plant was placed in operation in November, 1914, since when it has been in continuous operation; it has given entire satisfaction.

Swanson Bay Forests, Wood Pulp & Lumber Mills, Ltd.

The plant of the Swanson Bay Forests, Wood Pulp & Lumber Mills, Ltd., is favorably situated on Swanson Bay about 130 miles south of the City of Prince Rupert; it comprises a sulphite pulp mill, a large sawmill and wharves suitable for loading and unloading large vessels. Power is provided for the operation of some of the machinery by turbines aggregating 1250 h.p. operating under a head of 132 ft. A diversion dam has been built on Swanson Creek and from this point the water is conveyed to the turbines through a pipe line. The turbines were supplied by the S. Morgan Smith Company. The ultimate capacity of the plant is about 12,000 h.p.

Revelstoke Development on the Illicilliwaet River.

The hydroelectric development of the City of Revelstoke is on the Illicilliwaet River. A concrete dam across the canyon enables a head of 72 ft. to be obtained at the power house about 800 ft. down stream from the dam. Within the power house are installed two units supplied by wood stave pipes, the intakes of which are controlled by sluiceways in the dam.

The first unit consists of a 450 k.v.a. Canadian Westinghouse generator driven by a 900 h.p. Francis turbine at a speed of 450 revolutions per minute. The second unit is made up of a 750 k.v.a., 360 revolutions per minute, Canadian Westinghouse generator direct connected to a 1400 h.p. Escher-Wyss turbine of the Francis type, with double discharge; speed regulation is controlled by an oil pressure governor. Exciter units are in each case direct connected to their respective generators.

These units generate 3-phase, 60-cycle current at 2300 volts for use in the City of Revelstoke, and for the shops of the Canadian Pacific Railway Company.

Hydroelectric Development on Juniper Creek at Skeena Crossing.

In connection with the development of a high grade copper proposition owned by the Rocher de Boule Copper Company, and which is under lease to the Montana Continental Development Company, a small hydroelectric plant has been installed on Juniper Creek about $4\frac{1}{2}$ miles from Skeena Crossing.

A 187.5 k.v.a. Canadian General Electric 3-phase, 60-cycle, 2300-volt generator, belt driven by a Pelton-Doble water wheel has been installed.

Water is obtained from an intake on Juniper Creek and is conducted to the power house through a wood stave pipe line 3783 ft. in length, made up of 1000 ft. of 24 in. pipe, 1000 ft. of 22 in. pipe, 1000 ft. of 20 in. pipe, and 783 ft. of 18 in. pipe. The maximum heads on these pipes are respectively 50 ft., 100 ft., 150 ft. and 212 ft. The effective head at the water wheel nozzles when the unit is operating under full head is 178 ft.

Fortunes Creek Development at Armstrong.

The municipality of Armstrong owns and operates a hydroelectric plant on Fortunes Creek which provides light and power for the City of Armstrong. The water supply of the city is also obtained from this creek.

Fortunes Creek is a stream about 15 miles long, rising in the hills northeast of Armstrong at an elevation of 3500 ft., and discharging into the Shuswap River. The flow of the stream is variable, and for three months in the year the discharge is so small that an auxiliary Diesel engine set is used to provide the necessary power during these months.

A timber crib diverting dam forms an intake for a wood stave pipe line which is joined to a 10 in. steel pipe line at the top of the cliff behind the power house.

The equipment consists of a 100 kw. Canadian Electric generator driven direct at a speed of 900 revolutions per minute by a 150 h.p. Pelton water wheel. The Diesel engine set consists of a 200 h.p. Diesel engine driving a 125 kw. generator. Both units are of the 3-phase, 60-cycle type and generate current at 2300 volts. A three-panel switchboard is provided for controlling the power house equipment.

Hydroelectric Development on Murray Creek, Near Spence's Bridge.

Murray Creek is a small stream which rises in the Murray Mountains at an elevation of 4000 ft. above sea level, and flows southeast discharging into the Thompson River at Spence's Bridge at an elevation of 700 ft.; it is about 10 miles in length. The precipitation over the watershed does not exceed 20 in.

About a quarter of a mile from the mouth of this

creek there is a fall over 200 ft. in height; at the crest of this fall a small timber dam has been constructed which diverts the water from the stream into a tunnel 200 ft. in length. To the lower end of this tunnel a pipe line 10 in. in diameter is connected, which conveys water to the power house.

The power house is a concrete building 34 ft. in length and 24 ft. wide; the static head at the power house is 255 ft. The generating machinery within the power house consists of a 75 kw., 6 pole, single-phase alternator running at 200 revolutions per minute, which is belt driven by a Pelton water wheel running at 250 revolutions per minute.

The energy is transmitted to Spence's Bridge, a distance of about three-quarters of a mile, at 7500 volts, and is there transformed down to 110 volts for lighting purposes.

Hydroelectric Development at Glacier.

The waters of the Illicilliwaet River are also used at a small hydroelectric installation at Glacier, the electric energy being used for lighting the Canadian Pacific Railway Hotel at that point on its transcontinental line.

The power house is a frame building 21 ft. long by 17 ft. wide, and provides accommodation for two 25 kw., 125-volt generators, each of which is belt-driven by a turbine of 50 h.p. at a speed of 1050 revolutions per minute. The head utilized is 90 ft. Current is transmitted to the hotel over a transmission line 1800 ft. long.

Water Power Development at Field.

The mill of the Mount Steven Mining Syndicate is operated by power derived from the development of Cathedral Creek, a small tributary of the Kicking Horse River near Field, B. C., on the main line of the Canadian Pacific Railway.

A small diverting dam 9 ft. high provides an intake for a wood stave pipe line 12 in. in diameter and 1700 ft. in length, which delivers water to a 100 h.p. Pelton water wheel under a head of 300 ft. The main shaft in the mill is driven from a pulley 36 in. in diameter on the water wheel shaft.

Prior to the installation of this water wheel, steam power was used to drive the mill machinery, and it has been found that a very great reduction in operating expenses has been made since the water wheel was installed.

Nass River Development of the Kincolith Packing Company, at Mill Bay.

The Kincolith Packing Company owns and operates a cannery at Mill Bay in Northern British Columbia, and to provide power for the operation of this cannery during the fishing season a small water power development utilizing the waters of Nass River has been constructed.

The Nass River is fed by three small lakes at an elevation of about 360 ft. above sea level. An 18 ft. dam has been constructed at the outlet of one of these lakes, and a 10 ft. dam at the outlet of the lake nearest the cannery.

The water wheel equipment consists of three Pelton water wheels, each of about 30 h.p. capacity, and one 90 h.p. Pelton water wheel. The length of the pipe line between the intake and the cannery is about 2000 ft.; the static head at the water wheels is about 330 ft.

DIESEL ENGINE PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

Care and Operation of Earlier Types of Engines.

(Concluded.)

The casting which contains the fuel needle and the other accessories to the fuel valve is known as the fuel cage. This cage is an iron casting which is subjected to high pressure. The high pressure in this valve is confined in the steel bushing which is pressed into the casting. The injection air and fuel oil connections are both screwed into steel bushings. Water circulated around the bushings keeps it cool and prevents overheating of the fuel oil. The fuel needle is made of a special alloy with a cast iron spring case on the outer end in which the spring operates to close the valve against the action of the fuel cam.

The best quality of woven vulcabeston, or similar material, should be used for packing the fuel needle stuffing box; the packing must contain no rubber or gutta percha, as oil quickly softens and destroys these materials.

The atomizer where the injection air and fuel oil meet before entering the cylinder must be frequently examined to see that it is not clogged with dirt, which may come in the oil, or scale from the pipes. As a precaution against the clogging of the atomizer keep the oil strainer clean. The fuel needle seat should show a ring all around about 1/32 in. wide and should not require grinding very often. A reamer and guide should be on hand to ream this seat when necessary, and great care must be taken to apply an even pressure to the reamer to prevent chatter marks which would spoil the seat. To prevent undue wearing of the needle withdraw it once a week and oil the packing with graphite and cylinder oil applied by means of a rag on a wire. The needle may readily be withdrawn after loosening the gland nuts.

The exhaust valve seats in some engines are not removable. It may be reamed when necessary, using the guide furnished with the reamer which fits into the head. Care must be exercised to cut as little as possible from the seat and to maintain an equal pressure on the reamer to insure a true and smooth surface. When the valve needs refacing it should be put into a lathe and skimmed off by a competent man, removing no more material than necessary to true up the face and maintain an angle of 45 degrees.

It is the writer's opinion that all Diesels should be provided with a safety valve on each working cylinder. This valve is intended to relieve any undue pressure in the cylinder and is set to open at 800 lb. per sq. in. The piston traveling slowly downward at the time the first ignition takes place allows the pressure to increase above the normal; the relief valve is intended to take care of this increased pressure. Also in case needle should stick open and allow the fuel to enter the cylinder during the compression stroke a premature ignition will occur, this increased pressure causing the relief valve to pop and give warning that the fuel needle is sticking.

The fuel pump consists in general of fuel plungers, suction valves and discharge valves, together with their driving and controlling mechanism. The plungers are driven by eccentrics and are attached to the suction valve mechanism by means of connecting rods

and eccentric levers. Oil is delivered to the chamber in which the plunger travels through a mechanically operated suction valve. The plunger in its turn delivers the oil through the discharge valve to the fuel valve on the engine cylinder. The opening of the suction valve is controlled by an eccentric fulcrum, the position of which is regulated by a governor according to the load on the engine. At full load the suction valve starts to open at about mid-position of the plunger on its downward suction stroke and closes about mid-position on the upward delivery stroke. At no load the suction valve remains open during complete upward stroke of the plunger. The fuel pump suction valve is made of steel and the valve stems are nickel steel. The stuffing boxes of these valves should be packed with Blackhawk or similar packing, just tightly enough to prevent leakage as excessive friction prevents the springs from closing the valves promptly and affects the regulation of the engine.

Careful straining of the fuel oil is an important factor in the successful operation of these valves. Dirt or scale may mar the seats sufficiently to affect the operation of the engine. In case of such injury to a suction valve the seat should be reamed with a tool provided for this purpose and the valve trued up in a good lathe by a careful workman. The valve should then be ground in the seat with very fine emery and finished with pumice stone.

When replacing the valve cage after having cleaned all parts of the valve, be sure to get the lower joint tight, otherwise no oil will be delivered to the fuel valve and no work done in the cylinder. This joint is made with a corrugated brass gasket. Both surfaces of the joint must be thoroughly cleaned and the hole in the gasket must be large enough not to interfere with the operation of the valve.

The fuel pump discharge valves usually consist of hardened steel balls in steel cages. When the fuel oil is thoroughly strained and contains no grit, these valves require little attention. Should they become worn the seats must be reamed and a new ball put in place. To seat the new ball only one solid tap of a hammer is necessary. A ball set should be used for this work, using the guide which comes with the reamer as a guide for the ball set. The ball set is made of brass or steel with a brass tip so that the ball will not be marred. The lift of the ball should not be greater than 1/16 in. When it becomes greater than this, due to wear or reaming of the valve seat, it is necessary to use a new cage. Test the discharge valve to know that it is tight. To do this, disconnect the supply pipe between the discharge valve and the fuel valve. Place a cage on the outlet of the discharge valve and operate the fuel pump by hand to obtain a pressure of 75 atmospheres on the cage. If the pressure does not remain constant, look for a leak in the gasket, the discharge valve or the suction valve.

The injection air pressure should be graduated according to the load. At half load, and under, it should range from 50 to 60 atmospheres, or 450 lb. to 900 lb. per sq. in. Above half load from 65 to 70 atmospheres, 975 to 1050 lb. per sq. in. It is desirable when the peak of the load runs over the rated load of the engine, to use 75 atmospheres, 1125 lb. per sq. in.

If this pressure is too low for the load of the engine the exhaust will smoke. If it is too high the engine will knock. The pressure of 75 atmospheres is absolutely safe, as all high pressure fittings furnished are tested to a pressure of 3000 lb., the valves to 2500 lb. and the tubing to 6000 lb. The gauges which indicate the injection pressure should be frequently calibrated.

In every engine room there should be one gauge fitted with a valve and this valve kept closed. This gauge may then be used at any time for comparison with others. By holding one gauge in reserve the others may frequently be checked and when found incorrect, easily adjusted. A sudden increase or decrease of pressure often causes a gauge to read incorrectly. To positively check gauges for correctness they should, say every six months, be tested by means of a gauge tester. Gauges in use for some time tend to read high and lack of air pressure will make the engine appear overloaded.

The cylinders of practically all Diesel engines are lubricated by force feeding. The lubricating pump in some types is driven from the end of the cam shaft and must always receive proper care. The connecting rod boxes, shaft bearings, cam rollers and all wearing surfaces enclosed in the crank case are kept well oiled by the splash or forced lubrication. In splash lubrication the oil is thrown by the crank and conveyed to the various parts by oil grooves and oil holes designed for the purpose.

The oil cups on the fuel pump and governor must be kept well filled. No lubrication is necessary for the admission or exhaust valves, but the admission valve dash pot should occasionally be oiled. Where splash lubrication is employed three or four pints of oil should be added every four hours to crank pits. Three or four bucketsful of water should also be added to crank pits at this time. Some engines will evaporate more water than others. The engineer should use his judgment in order to keep the level in the crank case about right.

It is of the utmost importance that the fuel valve be correctly timed, that is, that it opens to admit fuel at the proper time and closes at the correct moment after the fuel is all injected. Every Diesel engine builder will furnish with his engine a table giving the correct measurements for his special engine. A typical diagram is shown in Fig. 10. If the fuel valve opens too early the pressure in the cylinder will increase. This condition should be avoided as it causes excessive wear of the engine bearings without increasing the engine capacity. Do not increase the lead beyond that given in the table, with the idea of forcing the engine to pull more load. The figures given are sufficient and if the engine will not pull its rated load when adjusted correctly look elsewhere for the trouble. If the fuel valve opens too late difficulty may be encountered in pulling the rated load. If the fuel valve closes too early the engine may have a smoky exhaust and burn too much fuel for the load which it is running. If the fuel valve closes too late injection air will be wasted. When setting the fuel valve compressed air in the air storage bottle should be used to indicate the exact time of the opening of the needle. To ascertain the point of opening this valve proceed as follows:

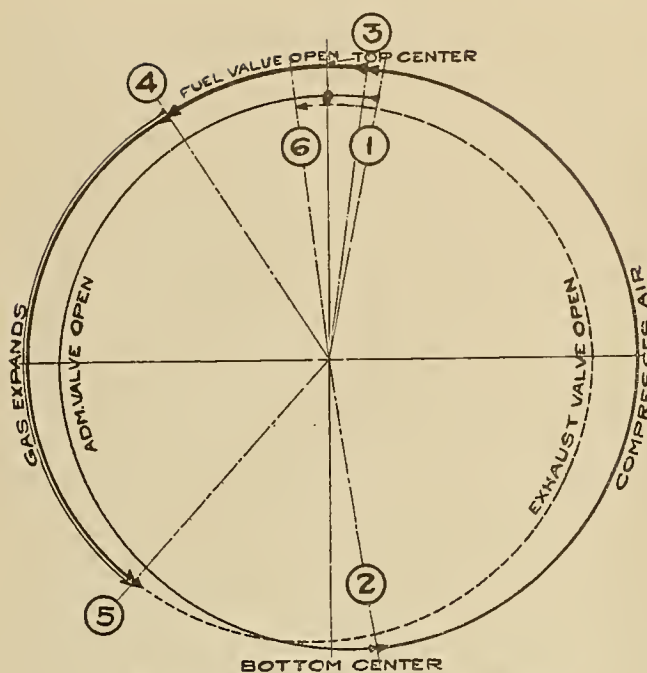


Fig. 10. Typical Valve Timing Diagram.

By barring the fly wheel, set the engine a few inches back of the position at which the valve should open. Pull up lever that relieves the compression on the cylinder or take out the indicator plug. Then turn the fly wheel ahead until the required lead is reached, whether it be $2\frac{1}{2}$ or 5 inches or more before the dead center-mark on the wheel when set at the proper measurement according to your table for the lead; turn on the injection air and listen at the indicator hole for a leak by the needle into the cylinder. If you hear nothing, change the adjustment of the valve rod until you just hear the least bit of air blowing by. Be very careful about this adjustment and see that the blow is the same after you have regulated your adjustment.

To ascertain the point of closing of the fuel valve turn the fly wheel ahead slowly until no air is heard to escape from the fuel valve when valve on the air line is open. Determine the point of closing by measuring from this point to dead center position. If the correct opening and closing of this valve cannot be accomplished by adjusting the vertical push rod it is then necessary to move the fuel cam nose slightly forward or backward, as the case may be, in the cam body. When the fuel nose is in its correct position any space between the ends of same and the fuel cam body should be carefully and tightly filled with metal shims to insure the nose remaining securely in its place. It is good policy to check the timing of these valves at least once a month. Always check and properly time these valves after a fuel needle or atomizer has been removed or reground, and also at any time that it has been found necessary to take the needle out or to remove the valve cage.

There are quite a number of differently designed Diesel engines at this time and no doubt the number will increase rapidly, due to the number of manufacturers going into the Diesel engine building, but all true Diesels work along the same lines. Some are horizontal and some vertical, but the timing of the valves

is practically the same. Some of the latest designs have all valves in the top of the head. This type of engine does not require as high a spray pressure as some of the others, air pressure ranging from 40 to 65 atmospheres, 600 to 975 lb. per sq. in., according to the load.

To remove sediment from the bottom of a boiler the blow-off valve should be slowly opened wide in the morning or before the circulation has started. After a few moments it should be closed slowly so as to avoid shocks from water-hammer.

The patent office, for the first time in years, has disposed of as many applications as were received. On June 30, 1914, there were 22,283 applications waiting action, and on June 30, 1915, there were 18,270. The number of patents granted in 1914 was 38,225; in 1915 the number was 44,402.

An electric condenser consists of two conductors separated by a non-conductor. Its ability to retain a certain quantity of electricity is known as its capacitance, and depends upon the area of the conductors, the distance between them and the nature of the non-conductor or dielectric. In mechanical terms the effect of capacitance corresponds to inertia. Condensers are extensively used in telephone apparatus and condenser phenomena are met in long-distance, high-tension transmission or in cable distribution.

A steam condenser is an apparatus whereby exhaust steam from a turbine or engine is cooled and converted into water. A jet condenser is used where the supply of cooling water is limited, the water being allowed to mix directly with the steam. A surface condenser is used when the supply of cooling water is large and water for steaming purposes small, the cooling water passing around pipes through which the exhaust steam circulates. The condensed steam is then pumped to the hotwell so as to be used again.

Slide-rule solutions of quadratic equations can be quickly accomplished by first reducing the equation to the form $x^2 + bx + c = 0$, in which b and c are any positive or negative real numbers. Set the hair-line of the slide-rule runner over c on the D scale. Then move the slide and mentally add the readings on the C and D scales until the slide is in such a position that the algebraic sum of the readings is equal to b . These readings are the required roots. Thus in the equation $x^2 + 3.97x + 3.85$, set the hair-line over 3.85 on the D scale. When the left index of the slide reads 1.5 on the D scale, the hair-line reading on the C scale is 2.565, their sum being 4.065. When the index reads 1.9, the hair-line reads 2.025, and the sum is 3.925. The first sum is greater and the second is less than b , which should be 3.97. The proper position of the slide index must therefore be between the two. Moving the slide back toward the first position and watching the variation in the sum of the two readings, we come to the index setting of 1.68 on the D scale and the hair-line reading of 2.29 on the C scale, their sum being 3.97 or b .

REPORT ON COLUMBIA RIVER POWER PROJECT.

BY L. F. HARZA.

Appendix D. Available Head as Limited by Backwater Conditions.

Limiting conditions. The practicable limit to which the headwater of a power station can be raised is sometimes determined by the height of the banks of the stream or other topographical features at the damsite, sometimes by the relation of the height of dam to its economy or feasibility, at other times by the elevation of some bench suitable for a canal location, but still more often perhaps by property damages from overflowed areas upstream from the dam, or by a combination of any or all of the above. In the case of this project the last named influence is very important and will receive first consideration.

Relation of Head to Railroads. Fig. 1 (p. 377, *Journal of Electricity, Power and Gas*, Nov. 13, 1915) is an outline map of the river from The Dalles eastward to the limit of any important backwater influence, showing towns and railroads. Two trans-continental railroads follow the banks of the river from Portland eastward past our damsite and some 130 miles or more above. The Oregon-Washington Railroad & Navigation Company's main line, on the south or Oregon shore of the river, was built in 1881 and 1882; the Spokane, Portland & Seattle Railroad, on the north or Washington shore, owned jointly by the Northern Pacific and Great Northern lines, was built in 1905 to 1907.

The O-W. R. & N. was thus constructed prior to the record flood of 1894 and was in reality submerged by this flood through many miles of its length. A considerable portion was washed out at this time, from the damsite upstream toward Umatilla and also at places below the damsite toward Portland, and was entirely out of service for several months during, and subsequent to this flood. The company was at this time in the hands of a receiver and the immense burden imposed upon it by the necessity of reconstruction caused it to be rebuilt in the cheapest possible manner by following the physical standards of the original railroad. Since that time many improvements have been made in alignment, and the line has been double-tracked from The Dalles eastward to Biggs and graded for double track still further eastward. As a result of these improvements, however, the road has been raised in grade but little, so that in case of a repetition of the 1894 flood it would still be submerged for many miles.

The S. P. & S. was built with reference to elevations established by this flood. It is a single track road of high physical standard without adverse grade and with a maximum grade of 0.2 per cent compensated 0.04 per cent for curvature, and with maximum curvature of 3 per cent between Portland and Pasco.

Fig. 5 (p. 377, *Journal of Electricity, Power and Gas*, Nov. 13, 1915) shows the sub-grade profiles of both railroads from The Dalles eastward about 43 miles, also the profiles of low water, of the 1894 floods, and of the Celilo Canal. It will be noted that upstream from the damsite the O-W. R. & N. is high for about four miles and from there upward is below the elevation of the 1894 flood to above Squally Hook Rapids,

some 27 miles, while the S. P. & S. railroad would have been submerged nowhere.

Importance of extreme flood. The head and power capacity assumed to be available at any power site depend to a considerable extent upon the provisions which must be made for extreme low water and high water conditions, which in turn depend upon the nature of the load to be served. As the chapters relating to the prospective market plainly indicate, this project must depend for success largely upon electro-chemical industries. For such industries an occasional sacrifice for a few days or even weeks, at intervals of a few years, is usually to be preferred over the increase in the purchase price of power which would be made necessary by the installation of steam or other auxiliary power to care for the deficiency during low water, or the installation of extra generating units to care for the deficiency during floods. Extremes of high or low water will therefore be ignored to a degree depending upon their frequency and duration, except where they affect the safety of a structure.

In Appendix B it is shown that the probable frequency of the 1894 flood is only about once in 1000 years, which figure although not numerically dependable, nevertheless indicates that it is such a remote contingency that it may be ignored in choice of controlled headwater elevation, assuming that in such an event a sacrifice in station capacity or even a total shutdown might better be borne. Neither would damage to property caused by a repetition of the 1894 flood be chargeable to the power project, provided the controlling works of the proposed power development did not raise the water at the damsite above its elevation in 1894.

Although such an infrequent flood as 1894 can be ignored in so far as its occurrence might interrupt the operation of the station or reduce the revenue, yet the case becomes quite different when we consider the design of the flood controlling works. These works must be designed to care for some margin of safety over the highest flood on record to provide for a possible flood of greater magnitude, for inaccuracies in the hydraulic coefficients used for the design of spillway, and for inaccuracies in the records of flood stages upon which these designs were based.

Limiting flood. From Fig. 4 (p. 373, Nov. 13, 1915) a radical difference will be seen in the flood characteristics prior to, and since 1894. It will be observed that during the past twenty years, or since the 1894 flood, no annual flood has reached a value as large as 800,000 second feet, although prior to this period this flood was exceeded nine times in a record of thirty-seven years, or about one in four years, the average frequency in the entire fifty-seven years of the record being about once in six and one-third years, whereas it was shown in Appendix B that the probable frequency of this flood is once in five years. This flood has been adopted for this report as the limit to which full station capacity need be maintained and will be discussed in greater detail in Appendix E.

Head control program. The program of head control tentatively recommended is shown in Fig. 20, platted with relation to river discharge horizontally. All curves are shown for the known range of the river and are also extended to a flood of 1,400,000 second feet, or about 20 per cent above the flood of 1894.

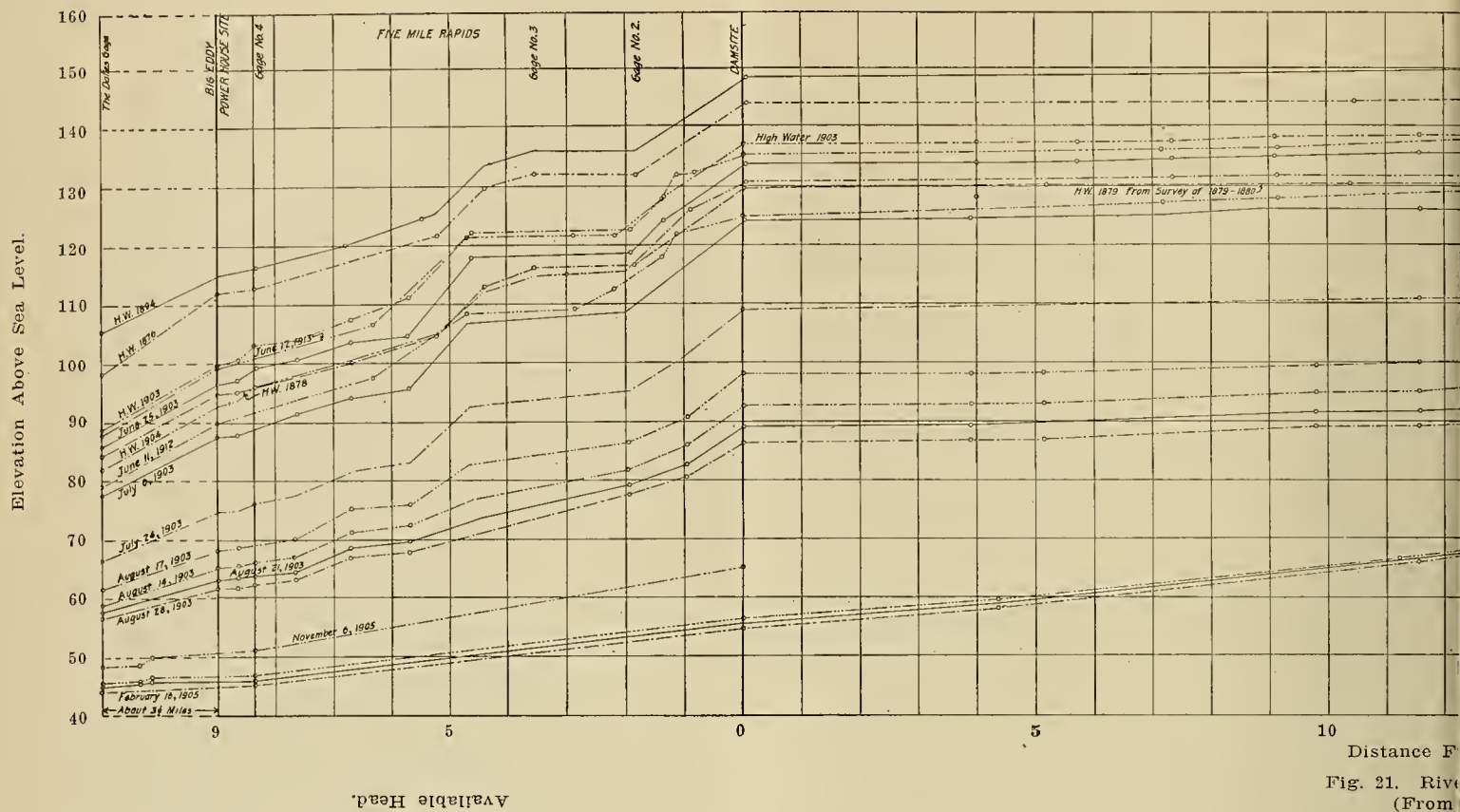


Fig. 21. River (From

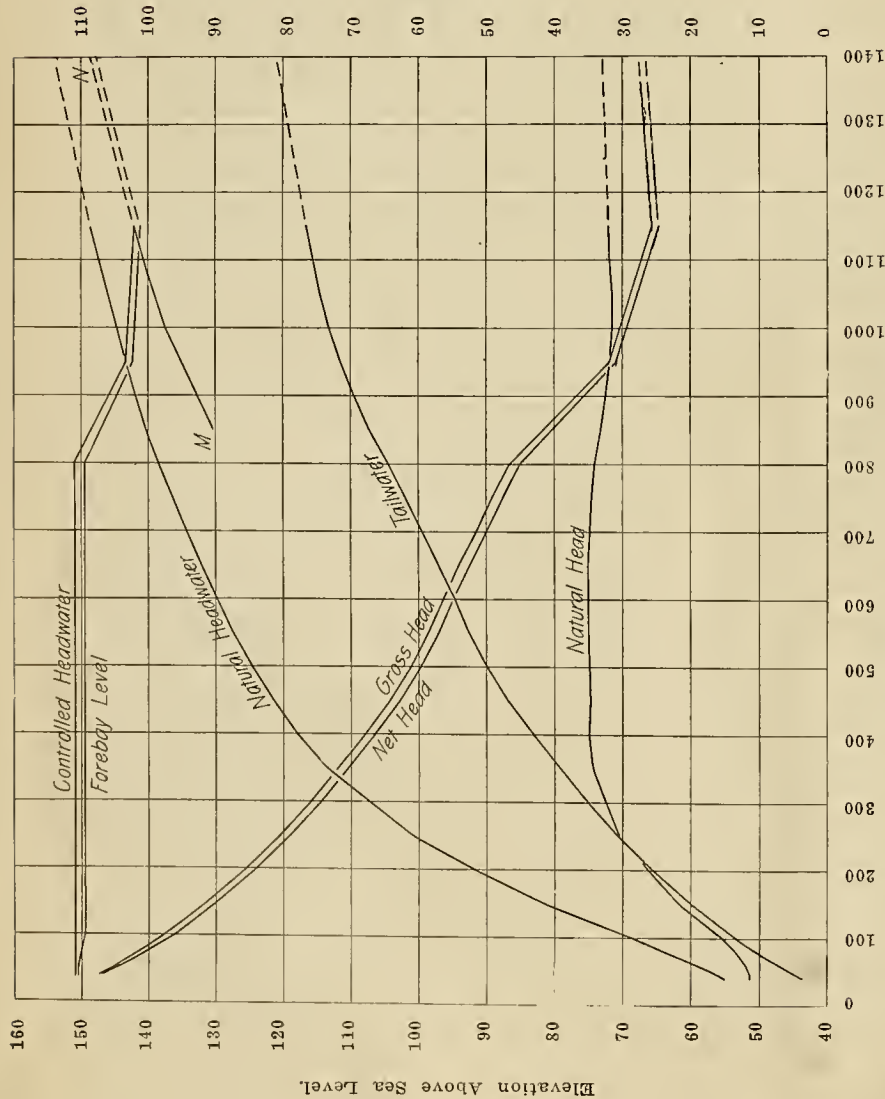


Fig. 20. Proposed Program of Head Control.

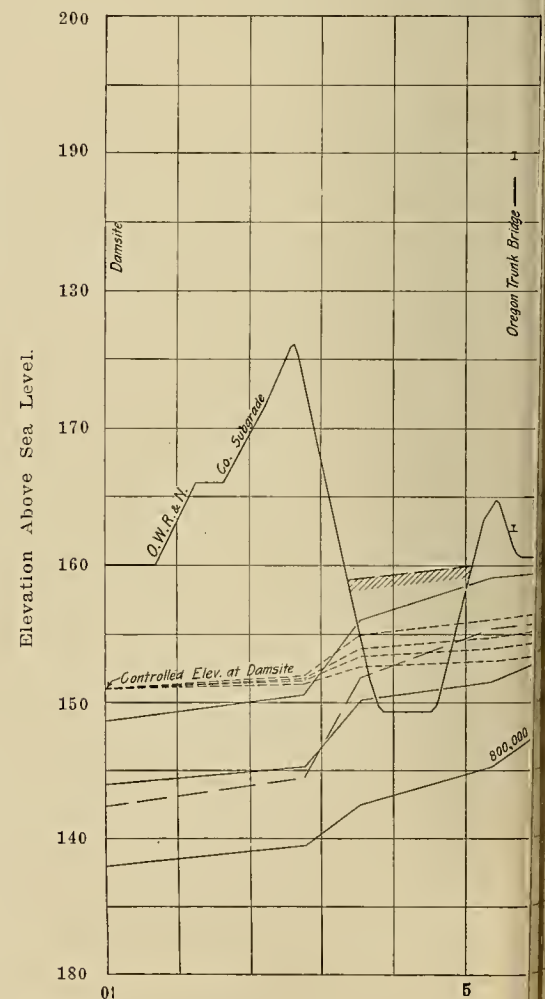
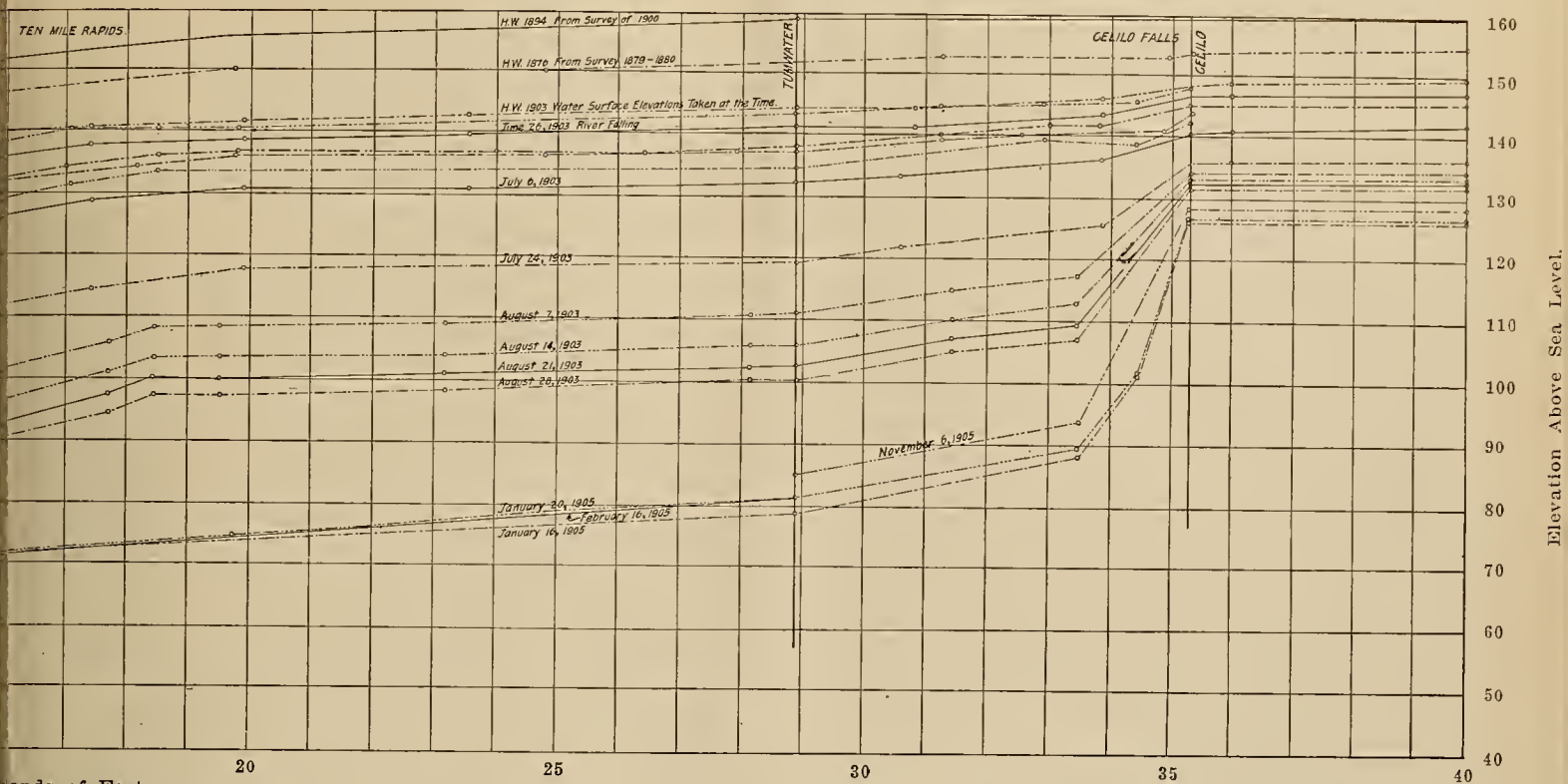
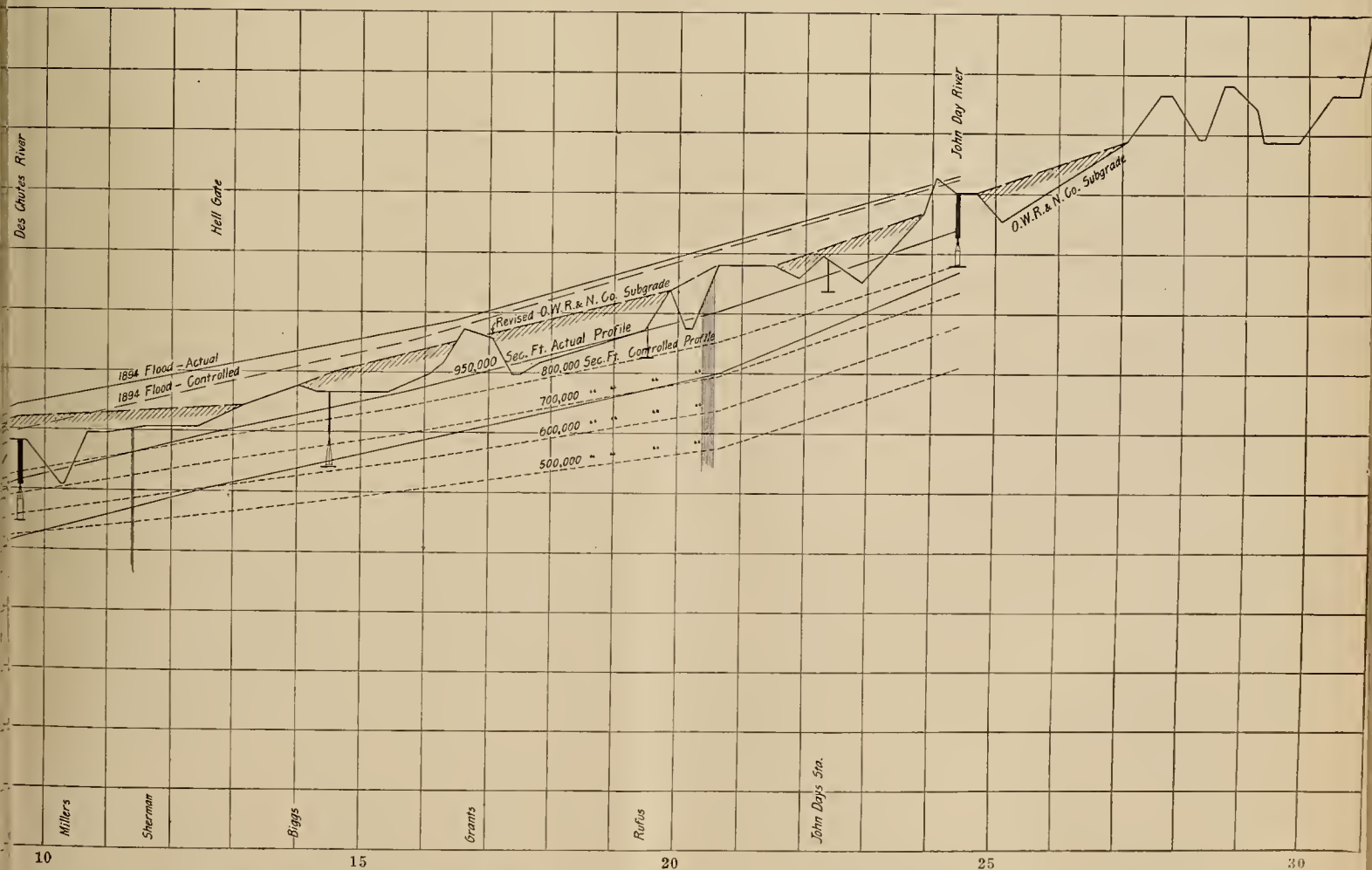


Fig. 22.



lands of Feet.
Dalles to Celilo.
Engineers.)



Distance Above the Dam Site in Miles.

for Controlled Elevation, 151.0, Showing Relation to O.-W. R. R. & N. Co.'s Present and Proposed Profile.

Curves of natural headwater and tailwater level and their difference, or the natural head, are also shown for general interest. It will be noted that the natural fall varies from about 11 ft. at low stages to about 35 feet at mean stage, again decreasing slightly during high floods.

The headwater at the dam is shown controlled to a constant elevation of 151.0 for all discharges below 800,000 second feet. This elevation is only 2.4 ft. higher than the flood elevation of 1894, and for this reason it would not increase the height to which all dams and controlling works would otherwise need to be built. A lower controlled level for this reason would not decrease the cost of such works and is not to be recommended from this standpoint. From 800,000 second feet to a flood of 950,000 second feet the headwater is assumed to be lowered uniformly until at the latter flood the natural elevation of the river at like discharge is reached. This latter flood was shown in Fig. 18, (p. 482, Dec. 25, 1915), to have a probable frequency of once in 25 years. Above this flood the gates are opened to lower the river below its natural level for the benefit of property upstream from the dam, until at 1,170,000, the 1894 flood, the line "MN" is reached, which is the line of headwater variation with all flood gates entirely open. For larger floods, should they ever occur, the water would again begin to rise along the line "MN" until, at 1,400,000 second feet, the natural level of the 1894 flood would be reached. The difference in elevation between the "controlled headwater" and forebay curves represents the drop in the 9000 ft. of power canal.

Controlled head. The tailwater curve shown in Fig. 20 is not in general subject to control and the head is therefore obtained by subtracting its elevation at any discharge from the corresponding elevation of headwater. Two curves thus obtained are shown, one representing the gross available head and the other the net head after deducting the loss in the power canal.

It will be noted that with the program of head control there indicated, a maximum net head of 107 ft. would be available at the extreme minimum flow of 41,900 second feet, the head falling off rapidly to about 105 ft. at the assumed usual minimum flow of 50,000 second feet, 45 feet at 800,000 second feet, thence to about 31 ft. at 950,000 second feet and 25 ft. at 1,170,000 second feet and above.

Backwater studies. The limiting headwater elevation of 151 ft. was selected by means of a study of the backwater curves for floods of various magnitudes and controlled elevation at the damsite. The available data permitted the computation of these curves with an unusual degree of accuracy. This was made possible because it is proposed to limit future floods to an elevation not greater than that of 1894. The controlled fluctuations in water level at all points except immediately at the damsite would thus be within the range of observed stages of the river and below the elevations of existing flood records of known magnitude. It was therefore possible to determine for any given controlled elevation and flow at any point along the river the natural flow of the river when at this elevation and the natural corresponding fall through

the stretch considered. The natural fall in this stretch of river was then decreased or increased in proportion to the relative squares of the flow under consideration to the natural flow at the assumed elevation. In thus determining the controlled fall of any given stretch of the river, the natural fall could be used in conjunction with the natural flow corresponding to the controlled elevation at the upper end, at the lower end or at the middle of the stretch by a process of successive approximations. The middle elevation would theoretically be best, but the upper end was used because it furnished a small factor of safety to allow for any change in hydraulic constants with the change in slope and velocity.

Very complete gage records of the river from Big Eddy to Celilo have been kept by the Corps of Engineers, U. S. A., during the investigations and construction of the Celilo Navigation Canal. Several profiles of this stretch of the river, from low water to maximum flood, traced from one of their drawings with necessary change in datum, are shown in Fig. 21. Above Celilo the low water profile was obtained from a survey of the Corps of Engineers, U. S. A., made in 1905; the flood profile for 1914 was observed by the project field party who also observed high water marks for 1913 and collected sufficient information regarding the 1894 flood to establish its profile with reasonable accuracy. These four profiles, which are shown in Fig. 5, made possible the platting of curves showing the relation of discharge to elevation at frequent intervals along the river from Celilo upward, each curve having at least four fairly trustworthy points; below Celilo similar curves were platted from Fig. 21 with a higher degree of accuracy than attainable above. The positions of these curves formed the division points between the successive stretches and the curves themselves furnished the data for the backwater computations. In Fig. 22 are shown the computed backwater curves for 500,000, 600,000, 700,000 and 800,000 second feet with a controlled elevation at the damsite of 151 ft.; also the natural profiles for 800,000 and 950,000 second feet and for the 1894 flood.

As outlined in Fig. 20, the proposed program of head control provides for some raise in water level above its natural elevation for all floods up to 950,000 second feet, and for this reason some occasional damage to agricultural property and to railroads would occur up to this limit. Although this flood is a very remote contingency and much damage would occur in that event even under natural conditions, yet it has been thought best for safety in estimates to assess the entire railroad reconstruction and purchase value of damaged lands to the power project, even though damage would occur only at intervals of several years and would not prevent the continued use of these lands. In this connection it should be said that only a very small amount of agricultural land would be affected, as the river banks up to the controlled elevation throughout most of the distance consist only of sand dunes and basaltic lava rock.

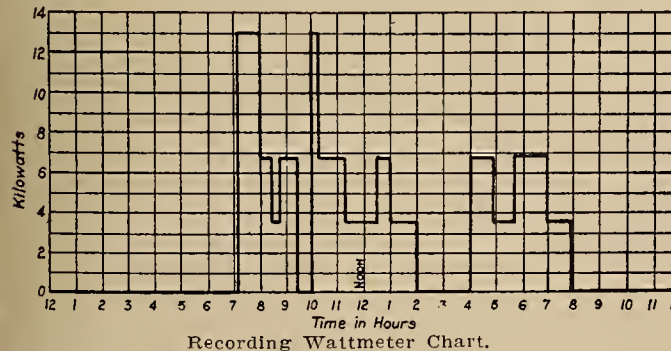
The O-W. R. & N. has been assumed as raised at each point where necessary to a safe clearance above the higher of either the 800,000 second feet controlled profile or the 950,000 second feet natural profile.

All recommendations as to the head to be adopted in order to be final, would necessarily be based upon comparative studies of the economy and unit cost of power for several assumed schemes of development and adopted headwater levels. It early became evident that neither time nor funds would be available for such comparative study and that the work would need to be limited to a fairly complete study of that scheme of development which might appear from general indications to be the most desirable and economical. The program of head control above outlined and used throughout this report must therefore be considered tentative.

In this chapter the natural conditions, chiefly the property damages, have been considered as limiting the available head. In the chapter on "Flood Control" the limits imposed by considerations of practicability of dams and controlling works will be discussed, and in the chapter on "Available Power" the practicability and economy of machinery for this wide range of heads will be considered.

ELECTRIC BAKE OVENS AT SALT LAKE CITY.
BY BAYARD W. MENDENHALL.

Early this year, the Salt Lake office of the Utah Power & Light Company became convinced that there was an excellent field there for electric bake ovens. They accordingly ordered a Hughes No. 150-36 loaf oven from the Hughes Electric Heating Company of Chicago, with the intention of trying it out and learning what merits, if any, electric baking had over the ordinary method. Early in April this oven was installed for a demonstration on the sales floor of the United Grocery Company, who were making at that time a special demonstration of flour, cake and other baked products. While the oven was installed there, several of the bakers and restaurant operators were taken to witness its operation. Mrs. Walden, in charge of the delicatessen department of the United Grocery, who had charge of the demonstration, spoke in the highest terms of the work done by this oven. Mr. C. A. Shay, proprietor of Shay's Cafeteria, ordered a No. 200 Oven—72-loaf capacity, for use at his cafeteria. This installation has been perfectly satisfactory. Mr. Shay states that the electric oven has cost him 20 per cent less to operate than the gas oven, which it replaced and that



he is able to turn out more products with his electric oven. The power company recently installed a recording wattmeter on this installation and kept a record of the maximum demand and consumption daily. The following is a summary of the results secured between October 7th and 29th while the recording instrument was in use.

Connected load rated.....	12 kw.
Maximum demand during period.....	13.4 kw.
Average maximum demand.....	13.2 kw.
Average daily consumption.....	65.67 kw-hr.
Load factor for period.....	20.40%
Load factor for the 13 hours in use.....	38%

The average weekly output of materials during the period covered by this test is as follows

700 Pies.	100 lb. Veal.
40 Loaves Nut Bread.	160 lb. Pork.
200 Loaves White Bread.	10 doz. Cream Puffs.
36 Loaves Raisin Bread.	10 doz. Patties.
38 Cakes, 1 layer, 10 in. diameter.	52½ doz. Rolls.
37 Cakes, 1 layer, 8 x 12 in.	17½ doz. Biscuits.
270 lb. Chicken.	16 Meat Pies, 15 x 20 in.
14 pans Common Bread, 15 x 20 in.	

The results of the demonstration also convinced Mr. Geo. Mueller of the Royal Baking Company of the superiority of electric baking and he ordered a No. 200 for use in his pastry department, which was installed in June. This oven has been so satisfactory that he has ordered another No. 150 36-loaf Hughes oven for use in his cafeteria kitchen for roasting meats and another No. 220 Hughes oven—120 capacity, to be used in his pastry department. He states that if this latter oven proves to be what he wants, as to size and arrangement, he will order a duplicate of it which will make four ovens, aggregating a connected load of 42½ kw., when the installation as now contemplated, is completed.

Several other ovens were sold shortly after as a result of the success of the first installation, including a No. 200 for Hart's Lunch Room, a No. 200 for Spary & Mehse, a No. 200 for the Package Grocery, a No. 200 for the Palace Market and a No. 200 for the Consolidated Grocery Company.

At the time the demonstration was made for the United Grocery Company, they were not in a position to consider the purchase of an oven. Recently, however, Mr. Smith, the manager, has purchased two No. 150 Hughes ovens and is preparing to make an installation which will be the finest advertisement for electric cooking and baking which it could possibly receive. These ovens will be located in a special department on the sales floor of their store and all of the pastry, cake and other products sold in their delicatessen department will be prepared and baked in the electric ovens in full view of the patrons to the store. They intend to make a special feature of the fact that their products are better because they are baked electrically. The store is now being remodeled to accommodate this department and the installation will be made the latter part of November.

We give herewith a tabulation of the consumption by months of the bake ovens now installed:

Name.	Hughes No.	Oven, Max. Demand.	Average Hr. Use.	K W.-Hr. Consumed.				
				May.	Jun.	Jul.	Aug.	Oct.
Royal Cafe.....	200	9	9	257 742 813 1139 1215				
				15 dys.				
Royal Baking Co.	150	4½	9					
Shay's Cafeteria.	215	12	13	1072 2056 2058 1846 2039 2101				
				15 dys.				
Hart's Lunch Rm.	200	9	13	1770 1759 1713 1402				
				9 dys.				
Spary & Hehse.	200	9	11	375 1533 2105 2005				
Package Grocery.	200	9	9	401 1512				
				15 dys.				
Palace Market...	200	9	9	625				
Con. Grocery.....	200	9		1180				
				2.2 kw.				
				Hot Plate.				

It will be seen that these ovens afford a highly desirable character of load and produce a most satisfactory revenue.

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POWER AND GAS

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A special committee of the American Society of Civil Engineers has been quietly at work for two years and a half on suggestions for a proposed national water law. This committee was appointed in accordance with a resolution submitted on May 7, 1913, by Mr. John H. Lewis, state engineer for Oregon. Its duties were to prepare a preliminary draft of a law "applicable to all navigable, interstate and other waters within the jurisdiction of the United States." The committee's progress report is to be submitted at the annual meeting of the Society on the nineteenth of January.

The report states that the enactment of a comprehensive law is now impossible, as Congress is restricted by the lack of constitutional authority. Furthermore the committee feels that engineers in general should have an opportunity to discuss certain fundamental principles which are laid down as a guide for any future legislation.

These principles seem in many respects to be the most enlightened and comprehensive suggestions as to a national water policy which have yet been formulated. They are predicated upon the assumption that the "highest economic use of water" is paramount to any question of whether the utilization be accomplished through private or public enterprise. This means, as far as the West is concerned, that domestic requirements, irrigation and power purposes, take precedent over navigation. The former add more to the wealth and welfare of the community and should consequently be given the preference.

The recognition of the relatively greater importance of irrigation over navigation is a point which unbiased and far-sighted engineers of the Pacific Coast have long recognized. This point is another of the long list of conditions which make the West different from the East. Heretofore the navigation interests have been successful in their opposition to the needs of irrigationists. Irrigation enterprise has consequently been greatly hampered in order that unused transportation facilities be provided. Now that powerful railroad commissions have eliminated the need for possible navigation as a club over railroad rates, irrigation should be given an opportunity for development.

The present federal laws regarding navigable streams were framed to meet conditions which have long since been changed. River navigation is conducive to the least good of the least number as compared with the benefits which accrue from the irrigation of semi-arid areas in the West. Therefore it is high time that the inadequacy of existing laws be remedied.

The investigations of this committee have also demonstrated that the restrictive policies of the past as regards the utilization of water should be abandoned so as to do away with the present stagnation in hydraulic developments. Unlike many other natural resources, water is best conserved when most completely utilized. Non-use is waste.

But above all else, the committee recommends local administration of water laws. "Much of the legislation required for the best utilization of the water resources of the country must of necessity

originate in the states rather than in the general government." The laws of the various Western states should be unified and then Congressional action should conform with them.

The federal government is manifestly within its prerogatives in making laws for interstate streams, these being the subject of the committee's investigations as regards a national water law. Their code of principles stipulates that each river system should be considered as a natural unit, regardless of political boundaries. "First in time is first in right" should govern past rights on interstate streams and "the highest economic use" should dictate future appropriations.

But no matter whether interstate or intrastate beneficial use should be "the basis, the measure and the limit of the right to the use of water."

The Naval Consulting Board has recommended that the government establish a plant for the manufacture of nitric acid from atmospheric nitrogen. By this recommendation the question thus becomes of public rather than of private interest. Where public preparedness requires an insurance of an ample supply of nitrates for the manufacture of powder, the usual deterrents to private investments are removed. Where private capital would hesitate to invest in an electric plant for the fixation of atmospheric nitrogen, the expense and even possible loss would not forbid governmental experiments.

Another hindrance to private operation is the probable opposition from surrounding land-owners due to the destructive effect of the escaping nitrous fumes on vegetation. The case is analagous to the sulphurous acid fumes from the copper smelters, concerning which there has been so much expensive litigation initiated by the farmers.

In this connection it is of interest to note that the report of the commission appointed to investigate alleged damage from the Selby smelter. (Bulletin 98, U. S. Bureau of Mines) concludes that the smelter does not maintain a nuisance and that the gases have no objectionable odor or disturbing physiological effects upon the mucous membrane linings of the throat and lungs of human beings and domestic animals. This result was attained by the smelter, however, only after years of expensive experiment and litigation. Like the inductive interference controversy, it demonstrates the superiority of science over law in adjusting difficulties.

While it has been possible for a few small-minded men to thus hold up a private enterprise which produces far more wealth than could ever be grown on the surrounding farms, no such likelihood is to be anticipated in the case of a government munition plant.

In Germany the private nitrate plants have been taken over by the government. In case of war similar action could be expected in this country. So it is not to be a subject of wonderment that private capital

has hesitated to entrust its monoplane to the shifting currents of air nitrate manufacture.

Another more attractive electro-chemical industry is the manufacture of caustic soda. During the past week announcement has been made of the formation of a big corporation to utilize the abundant salt and limestone supply in the vicinity of San Francisco bay, together with cheap electric power, for the manufacture of caustic soda, bleaching powder and various by-products. As the plans call for an initial consumption of twenty-five hundred electrical horsepower, another outlet will thus be provided for the utilization of hydroelectric power.

The manufacture of paper from wood-pulp, the reduction of potash and aluminum from feldspar and the preparation of graphite from waste lamp-black are attractive electro-chemical projects which will probably be realized in the near future on the Pacific Coast.

Action and reaction are equal and opposite. This fundamental principle is no truer in its mechanical meaning than in a human sense.

The Reward of Service Newton's third law of motion is but a specialized expression of

Nature's first law of service. Service rendered is an action, reward obtained is the reaction. No employe can exert a weak action of service and expect a strong reaction of pay; nor can any employer ignore the law of service and escape the payment of the penalty.

The thought is equally applicable to the individual worker and to the public service corporation. It is only a positive recording of the more passive statement "it is better to give than to receive." Every man is, in a sense, a telephone instrument, equipped with a transmitter and a receiver. It is only by constant use of the transmitter of service that there can be any return in the receiver.

Stated otherwise, this means that to get you must first give. This is well exemplified by the fact that the teacher learns more than the pupil. Furthermore, the less thought of reward in rendering service, the greater the pleasure of the reward received.

Service embodies the thought of each for all. It is the antithesis of that pernicious doctrine, "every man for himself and the devil take the hindmost." True service removes competition, except that desirable form of competition with one's self, whereby a man endeavors to make his present excell his past.

These are the thoughts which should actuate the salesman in selling goods for his house, the house in catering to its customer, and the customer in serving the public. To give is the best way to get, just as to forgive is the best way to forget. What you put in is a direct measure of what you take out. True success is a by-product of a life of service. When service ceases success flits. Like happiness no man can attain it if it is the one object sought. It comes from a forgetfulness of self in working for others. It is the result of giving, not of getting.

PERSONALS

Wm. Ford, electrical expert for the Railroad Commission of San Francisco, has just returned from a business trip in the south.

W. W. Beckett, of the New York office of the Stone & Webster Construction Company, is a recent arrival on the Pacific Coast.

B. M. Atkins has been appointed by the North Coast Power Company as district manager for Southwest Washington, with headquarters at Kelso.

B. J. Klein, Pacific Coast manager of The Bristol Company, Waterbury, Conn., has just returned to San Francisco from a short business trip to Los Angeles.

C. V. Schneider, electrical contractor of Sacramento, Cal., and president of the Electrical Contractors' Association of California, was a recent visitor at San Francisco.

J. B. Lukes, Pacific Coast manager of Stone & Webster Construction Company, expects to return to San Francisco about the end of the month from Texas, where he has been for the past month.

Albert Kramer, a recent graduate from the apprentice's course of the Westinghouse Electric & Manufacturing Company of East Pittsburg, Pa., has now joined the sales forces of the San Francisco office.

Wynn Meredith, member of the firm of Sanderson & Porter, San Francisco, Cal., expects to leave for New York about the end of the week to attend a conference with the officials of his company there.

C. F. Conn, manager of the San Francisco office of J. J. White & Co., recently left for New York to attend an annual meeting of that company, and is expected back at San Francisco about the 15th of the month.

Herbert I. Markham, general manager of the Federal Sign System (Electric) of Chicago, leaves that city on January 7th for an extended trip throughout the Western territory in company with I. W. Simpson, western district manager of San Francisco.

W. S. Hanbridge, formerly secretary of the Electrical Contractors' Association of California, has opened an electrical supply house at San Francisco. J. W. Redpath, formerly with the Technical Publishing Company, has succeeded Mr. Hanbridge as secretary of the Association.

J. B. Edwards has been elected president of the Kellogg Switchboard & Supply Company, and will also continue as general manager, a position which he has filled for the past ten years. L. D. Kellogg, the retiring president, has been elected chairman of the board of directors.

O. P. McCord, formerly sales engineer of the Westinghouse Electric & Manufacturing Company of San Francisco, has recently severed his connections with that company and has joined the sales forces of the Electric Railway & Manufacturers' Supply Company at San Francisco.

F. A. Easton, who has been in charge of the San Joaquin Light & Power Corporation's San Luis Obispo district for the past year, has been given charge of an electric range campaign which will cover the company's entire territory. D. P. Mason, formerly chief store keeper, has succeeded Mr. Easton at San Luis Obispo, Cal.

Knud Jensen, buyer for the Angel Muzzio and Hijos Electrical Importing Company of Buenos Ayres, is at San Francisco. Mr. Jensen states that his concern had previously imported most of the modern electrical appliances from Germany and some few from Italy, but that war conditions had given American manufacturers the whip hand. The South American visitor has been commissioned by his firm to place orders amounting to \$250,000 in the United States.

OBITUARY.

William Claflin Andrews, advertising manager of the Edison Storage Battery Company, Orange, N. J., died in New York City on December 21st. A graduate of Columbia University, Mr. Andrews afterward became sales engineer of the Stanley Instrument Company of Great Barrington, Mass., and later became connected with the General Electric Company in Schenectady, N. Y., and Harrison, N. J. He was for two years secretary of the Rae Company, New York City, leaving to join the Edison Storage Battery Company in April, 1913, where he was advertising manager until his death. Mr. Andrews enjoyed an unusually large acquaintance among electrical men, and was particularly active in the Electric Vehicle Association of America and in the Jovian Order, of which he was Statesman-at-large for New Jersey.

HOUSEWARMING AT ENGINEERS' CLUB, SAN FRANCISCO

The Engineers' Club of San Francisco celebrated the completion of its new home on the top floor of the Mechanics' Institute Building, by a dinner and Christmas tree celebration on Wednesday evening, December 29th. As nearly one hundred and fifty members were in attendance the new quarters were taxed to their capacity. During the dinner, W. W. Briggs, as toastmaster, introduced several entertainers to amuse the crowd and also called in more serious vein on C. C. Merrill and A. H. Babcock as past presidents to tell of the origin of the club and its accomplishments.

As junior past-president Mr. Briggs told of the efforts which had lead up to the present prosperous situation of the club. E. B. Bumstead, president-elect, extended hearty welcome. Brief remarks were also made by the presidents of the Commonwealth Club and of the Transportation Club.

Santa Claus, personified by Eli Hutchison, then jovially distributed gifts from the electrically-lighted tree to every one present. Each gift carried with it some humorous remark and was fully in accord with the spirit of the occasion.

The members then adjourned from the dining room to enjoy the comforts of the lounging and card rooms, remaining until a late hour. The entire assemblage voted the affair a great success and a credit to Wynn Meredith, chairman of the entertainment committee.



Lounging Room in San Francisco Engineers' Club.

The accompanying view gives an idea of the beautiful manner in which the quarters are furnished. Their convenient situation, combined with the excellent culinary service should make membership in a club a most desirable thing. The organization has been most successful, having 237 resident members, a large non-resident list, and "money in the bank."

MEETING NOTICES.

Coming Conventions of A. I. E. E.

At the meeting of the board of directors of the American Institute of Electrical Engineers, held December 10, 1915, it was decided to hold the usual Midwinter Convention in New York City, on February 8-9, 1916.

At the same meeting a Pacific Coast Convention, to be held in Seattle, Wash., under the auspices of the Seattle Section of the institute, was authorized, the date to be decided later. The programs of these conventions will be announced later.

Portland Sections A. I. E. E. and N. E. L. A.

The regular bi-weekly luncheon was held December 23, 1915, the attendance being 75. The speaker of the day was W. M. H. Galvani, civil engineer for the Pacific Power & Light Company. His subject was "Preparedness." His remarks were along the "Universal Peace" ideas. A Christmas present was given to each member present with the understanding that the package containing same had to be opened in the presence of the other members of the luncheon. This occasioned a great deal of fun, especially when a "bald-headed" man received a "curling iron."

Jovian Electric League of Southern California.

The final luncheon for the year 1915, held by the league at Christopher's, on December 29th, was marked not only by a large attendance, but a spirit of jollification and good fellowship, entered into by every one present and due, no doubt, as largely to the wit and enthusiasm inspired by the acting chairman, Allan E. Morphy, and the chairman of the day, Harry N. Sessions, as the natural effects of this season of the year. In the absence of President Holland, Vice-President Morphy reviewed the year's work of the league and earned for himself the gratitude of the treasurer, even if that of no other member by the imposition of exceptionally heavy fines, which contributed over forty dollars to the greatly over-worked treasury. But, after all is said and done, his inimitable wit largely outweighed this "imposition." Harry Sessions certainly made "good" when he coaxed the Costello girls to sing Spanish songs and dainty Miss Geisler to render a few clever ballads. The big treat of the day, however, was the reading by Benjamin F. Pearson, the greatly beloved superintendent of the Southern California Edison Company, of his very beautiful and poetic bit of prose, entitled "The Snow Flake in Industry."

Oregon Irrigation Congress.

The fifth annual session of the Oregon Irrigation Congress was held December 28, 29, 30 at the Imperial Hotel, Portland. The Jones bill was the chief topic for discussion, full endorsement being given to its provisions.

John H. Lewis, state engineer, presented a paper on "Meritorious Irrigation Projects as Shown by Co-operative State and Federal Surveys," wherein a brief description was given of the several Oregon projects, upon whose features reports have been made, Deschutes, Ochoco, Silver Lake, John Day, Malheur, Owyhee and Harney. He recommended that experiment stations be established to solve the marsh land problems.

Leonard Lundgren, district engineer, U. S. Forest Service, spoke on "Government Rights of Way for Oregon." After tracing the evolution of the Forest Service, he explained the necessary procedure in acquiring rights of way for irrigation projects.

Judge Carroll S. Graves of Seattle spoke on "Irrigation District Laws," urging some sort of federal aid in financing them. In this connection he explained the salient features of the Jones bill.

L. M. Rice, irrigation engineer at Seattle, read an address on "Construction Engineering," wherein he urged that engineers be of public service in encouraging the conservation and use of water for irrigation.

Other addresses were given by Governor Withycombe, E. G. Hopson, E. G. Young, Geo. M. Brown, O. Laurgard, J. T. Hinkle, I. N. Day, J. W. Kerr, J. A. Keating, R. D. Hetzel, Porter J. Neff and Arthur Hooker.

J. W. Brewer of Portland was elected president, F. N. Wallace of Tumalo secretary and H. H. De Armond of Bend, A. D. Anderson of Madras and C. C. Clarke of Arlington, vice-presidents. Resolutions were adopted endorsing state aid for irrigationists.

CALIFORNIA WATER COMMISSION APPLICATIONS.

Bridget Graham of Colusa has made application to the commission for a permit to appropriate 31 second feet of the waters of Sacramento River at a point in the NW. $\frac{1}{4}$ of the NW. $\frac{1}{4}$ of Sec. 5, Tp. 16 N., R. 1 W., M. D. M. A 100 h.p. motor connected to a 20 in. centrifugal pump, a 30 in. steel pipe to the river, with a system of ditches, furnishes the method of diversion. The plant is intended to irrigate 1100 acres and the estimated cost is \$5500.

Samuel P. Hale of San Jose has made application to the commission for a permit to appropriate 40 second feet of water from Jackson and Hale Creeks, in Fresno county in Secs. 34 and 35, Tp. 16 S., R. 13 E., M. D. M. His dam of earth and concrete is estimated to cost \$1000. The system is designed to water 345 acres.

W. H. and J. S. Garrison of Victorville have asked for a permit from the commission to appropriate 50 miner's inches of water from Crystal Creek in San Bernardino county, for purposes of irrigation. There is a pipe line one and one-half miles long in the diversion plan. Location Sec. 1, Tp. 3 N., R. 1 W., S. B. M.

James Poindexter and John L. Davis have applied to the commission asking for a permit to appropriate 120 acre feet of water from Dry Ravine, tributary to Goose Lake, Modoc county. Their storage dam will be of earth and cost about \$200. A ditch a mile and a half long will convey the water to the land. The applicants are residents of Davis Creek.

J. A. Baxter of Independence, Inyo county, has asked permission of the commission to appropriate 40 miner's inches of water from Nine Mile Creek in that county, and by a pipe line four and a half miles long convey the water to his lands. He has a concrete diversion dam and ditch in his plans.

H. H. Gable of Esparto, Yolo county, has applied to the commission for permission to use the waters of Oat Creek, a tributary of the Colusa Basin, to the extent of 80 miner's inches. There is no main canal, the water to be stored in a reservoir until there is enough for a day's run for an eight inch pump, which will throw it into the distributing ditches. The dam will be of reinforced concrete, with 54 sq. ft. of openings to discharge the flood flow. The estimated cost is \$1600, and there are 160 acres to be irrigated.

The Sutter Butte Canal Company of Gridley has applied to the commission for permission to appropriate waters to the extent of 50 second feet from Hamilton Slough, tributary to Butte Creek in Butte county. The waters applied for are those which escape from drainage of lands irrigated by the same company's system, which flow into Hamilton, Henderson and two other unnamed sloughs. It is intended to install removable dams, which can be taken out in the period of flood flow. A pumping plant will be used in connection with this proposed diversion, which contemplates the irrigation of 8000 acres.

A. G. Clausen of Alturas, Modoc county, has filed his application with the commission asking for permission to appropriate 50,000 acre feet of the flood waters of Rattlesnake Creek in that county, tributary to the Pit River. The proposed diversion is for irrigation of some 20,000 acres of land and the works are to be known as the Big Sage Irrigation System. It calls for a storage dam 40 ft. high, 500 ft. long and 20 ft. wide on top, built of earth and stone with a concrete core.

Manuel Garnier and Fred Osborn of Doyle, Lassen county, have applied to the commission for permission to appropriate for purposes of irrigation 25 second feet of the waters of Long Valley Creek. The estimated cost of diverting the water to 400 acres to be irrigated is \$3000.

Leon Bly of San Francisco has made application to the commission for permission to appropriate 30,000 acre feet per annum of the waters of Eagle Lake, Lassen county, which sink into the ground, carrying the water by means of a tunnel and canal to the natural channel of Willow Creek, from which the water is again reclaimed, turned into the bed of Susan River and again taken out and used to irrigate lands at the north end of Honey Lake Valley. The tunnel is to be 3880 ft. long, connecting with the canal 5933 ft. in length. Eagle Lake is characterized as a sink with an area of 29,000 acres. The application sets forth that between 1875 and 1915, the level of the lake had raised fifteen feet. It is proposed to tap the lake with the tunnel 11 ft. below the level and lower the lake eight feet, which with the annual average supply will furnish about 14,000 acre feet of water. The tunnel dimensions are given as six feet wide top and bottom and four feet deep at the headgate. The canal is given as 11 ft. wide on top and 7 ft. on bottom with depth of water, 4 ft. The elevation of the lake is 5000 ft. and the application states that it will take all of the open season of 1916 to complete data and that it will be impossible to commence construction work before June, 1917, and that on account of the short open seasons the work of construction would consume an estimated period of three years.

W. J. Browning of Grimes, Colusa county, has applied to the commission for permission to appropriate for agricultural purposes, waters from the source of Butte Creek, waters of overflowed lands tributary to it and waters from the drainage of irrigated lands which find their way into the creek. His point of proposed diversion is near the center of Sec. 17, Tp. 18 N., R. 1 E., M. D. M., in Butte county. By a diversion dam and canal he proposes to irrigate 320 acres.

The White and Friant Lumber Company of Chicago have applied to the commission for permission to appropriate 1000 miner's inches of the waters of Whiskey Creek, a tributary of the North Fork of the San Joaquin River, the point of proposed diversion being located in the NW. $\frac{1}{4}$ of Sec. 34, Tp. 7 S., R. 23 E., M. D. M. There is a storage reservoir to hold 500 acre feet connected with the proposed plan, the whole to be constructed at an estimated cost of \$200,000. The use is for fluming and general lumbering purposes.

The Sutter Butte Canal Company of San Francisco, but operating in Butte county, has submitted to the commission three separate applications for permits to use waters in that county, the waters being, in the main, waters that drain into various sloughs from lands previously irrigated from their ditches. One application covers 50 second feet from Hamilton Slough in the above county, for the irrigation of between 4000 and 5000 acres. Another covers 20 second feet from Cherokee Canal and a third Old and New Dry Creeks. In the latter two cases, it is proposed to install pumps to reclaim the water.

M. D. Graham of Wakefield has applied to the commission to appropriate 120 miner's inches of water from Growler creek in Del Norte county for purposes of mining.

BOOKS RECEIVED.

"Overhead Transmission Lines and Distributing Circuits." By F. Kapper, translated by P. R. Friedlaender, 300 pp., 8 x10 in. Published by D. Van Nostrand Co., New York, and for sale by Technical Book Shop, San Francisco. Price \$4.00.

Much can be learned from a study of methods used elsewhere. With this thought in mind this text is of interest and of value. After a brief introduction it discusses conductor materials, gives calculations for line sag and tension, shows how supporting structures are designed, brings out the in-

fluence of earth conditions on pole stability, gives many examples of pole construction and line erection, tells of line survey and gives English and German regulations for construction. American practice in general and Pacific Coast practice in particular is conspicuous by its absence. However, as an exposition of fundamental principles it brings into compact form many widely-scattered data.

TRADE NOTES.

W. C. Parish is doing the electrical work at 313 $\frac{1}{2}$ Washington street, Portland.

M. J. Walsh & Company are rewiring the Edwards Hotel, 149 Grand avenue, Portland..

C. P. Scott is installing the electrical equipment for the St. Johns Ice Company on Division street, Portland.

NePage, McKenny Electric Company has just completed the electrical equipment of the Port of Portland's new dredge "Twalatín."

The Metropolitan Electric Company has established headquarters at 524 First Ave. South, Seattle, as manufacturers of switches, switchboards, cabinets, boxes, etc.

The Jefferson Glass Company, Follansbee, West Virginia, has reopened their plant at Millersburg, Ohio, to relieve the pressure at the Follansbee factory, and to care for the Western trade.

Standard Gas Engine Company of San Francisco has recently been appointed Pacific Coast representative for the marine Diesel type engine, built by the Southwerk Foundry & Machine Company of Southwerk, Pa.

Morrison Electric Company of Portland has the contract for rewiring the portion of the Gerlinger Building recently destroyed by fire. J. B. Sturges is doing the electrical work at 265 Madison street, Central Garage, 235 Second street.

NEW CATALOGUES.

Hydraulic Machinery is the subject of Bulletin No. 1636 from Allis-Chalmers Manufacturing Company. This beautifully printed booklet illustrates and describes several modern hydroelectric plants where Allis-Chalmers apparatus has been installed. It also contains valuable hints on the selection of the correct type of units and details of turbine construction.

Fort Wayne Electric Works have issued two new bulletins on demand indicators. Bulletin 46102 illustrates and describes Type H, a heat-operated device of 3, 10 or 25 ampere capacity on voltage up to 500, either a.c. or d.c. Bulletin No. 46103 is devoted to Type M-2, whose demand registering element is electrically driven from the register of an independent watt-hour meter; the timing mechanism is a constant speed motor in a.c. instruments and a clock mechanism in the d.c. instruments.

Benjamin Electric Manufacturing Company have published a new Handy Lighting Manual, which contains a number of representative reflectors and fixtures particularly adapted for industrial lighting purposes, specialties and fittings; also a section in the rear devoted to illuminating information for the use of the lamp salesmen and engineers around plants. The articles listed are conveniently classified, the book is indexed and contains eight pages of blank ruled stock for making memoranda.

The Edison Storage Battery Company of Orange, N. J., has just issued a new bulletin on the use of the Edison nickel-iron-alkaline battery in commercial vehicle service. After enumerating some points of superiority of the electric wagon in delivery service and the effect that the Edison battery has had in increasing its simplicity, durability and reliability and in reducing the cost of maintenance and repairs and the labor attending them, the book briefly describes the construction of the Edison cell and gives examples of some of its remarkable characteristics such as long life, great mileage, ruggedness, service efficiency, cleanliness and ability to withstand extremes of temperature.



NEWS NOTES



FINANCIAL.

PORT ANGELES, WASH.—The Olympic Power Company, with offices in Port Angeles and a power plant on the Elwha River, has been placed in the hands of the receivers, who are H. E. Sims, Port Townsend, and C. L. Haggith, Port Angeles. The issues amounting to \$800,000 are said to be due.

OAKLAND, CAL.—An application for the appointment of a receiver for the Oakland & Antioch Railway was filed recently in the Superior Court of Contra Costa county by Howard D. Smith and three other holders of first mortgage bonds. This suit is regarded by those guiding the reorganization plan as a block to their efforts, which have not as yet received the complete approval of the railroad commission. The charge made is that the O., A. & E. Ry.—the extension from Bay Point to Sacramento—is using the funds properly applicable to the payment of the bond interest of the O. & A.—the original line from Oakland to Bay Point—to pay its own obligations. The contention is that the debts of the "Eastern" are in this way made a senior lien on the property of the "Antioch." The complaint also charges that the Anglo-California Trust Company has become disqualified to act as trustee of the \$2,000,000 bond issue of the "Antioch," by reason of loans made to the "Eastern" by the Anglo and London Paris National Bank.

INCORPORATIONS.

SEATTLE, WASH.—The Prince William Sound Water, Power, Light & Telephone Company has been incorporated here.

POCATELLO, IDAHO.—Pocatello Traction & Interurban Company has been incorporated at Pocatello, Idaho, for the purpose of installing a street railway system.

ILLUMINATION.

HEALDSBURG, CAL.—The Union Gas Company has made application to the city trustees to install a gas plant in Healdsburg.

ASTORIA, ORE.—D. S. Ewart plans to start at once the installation of an electric lighting plant at James Jamieson's ranch at Jewell.

FULLERTON, CAL.—At a meeting of the city trustees lately G. A. Lyster presented a petition requesting street lights in the southeast part of town.

SPOKANE, WASH.—The contract with the Washington Water Power Company to install an ornamental curb lighting system on Trent avenue, has been approved.

MILL VALLEY, CAL.—A communication to the trustees from the Union Gas Company indicates that the company is willing to establish a gas plant and operate it if the town of Mill Valley will lay pipes.

CULBERTSON, MONT.—Donaldson Brothers, owners of the local electric light plant, will make extensive improvements to carry additional current for street lights which are being installed by the council.

ORANGE, CAL.—A resolution of intention has been adopted by the board of trustees for the installation of street lamps on Glassell street, between Almond avenue and Maple avenue, and certain other streets.

NEWPORT, CAL.—The lighting committee recommends the completion of the city's lighting system and advises temporary lights placed from the 19th street pier to the pier on Ocean Front, and in various other places.

ONTARIO, CAL.—The city council has awarded the contract for the installation of an ornamental lighting system in West A street, between Laurel and Palm avenues, to the Granger-Hall Electric Company which was the lowest bidder.

LAMANDA PARK, CAL.—The election on the matter of forming a lighting district in Lamanda Park has been called off for two months. It is proposed to bond the district for \$25,000 to be used in the installation of 224 ornamental lights.

NEEDLES, CAL.—An ordinance has been adopted granting to the Needles Gas & Electric Company the right to install and operate for a period of 50 years a system of gas pipes, electric pole line and wire system, and telephone system in this city.

SAN BERNARDINO, CAL.—Representing property owners on E street, Third to Fifth streets, W. W. Brison has presented contracts to the city council from the owners for the installation of ornamental lights, an order will be given for immediate construction.

LEWISTON, IDAHO.—County Commissioner L. J. Southwick reports that the Potlatch country and the town of Peck are to be supplied with electricity by the Kendrick Light & Power Company. The company will furnish farmers all along the route with power and light.

DOUGLAS, ARIZ.—Plans for the ornamental street lighting system to be constructed on G avenue and Tenth street in connection with paving work have been submitted to the council by City Engineer Hall. Electric current is to be purchased from the Douglas Traction & Light Company.

OCEAN PARK, CAL.—Bids will be opened at the next meeting of the council for furnishing a lighting system for Pier avenue, between the Promenade and Main street. The section included calls for 20 lighting posts with clusters of five lights each. The cost of installing the system is estimated at \$1500.

PHOENIX, ARIZ.—Sealed proposals will be received at the office of the city manager until February 3d for furnishing all material and making extensions to the street lighting system of the city as per specifications on file in the office of the city electrician. Separate bids will also be received on material.

TRANSMISSION.

TACOMA, WASH.—The Puget Sound Traction, Light & Power Company will extend its lines to Ruston to furnish electric power, providing a franchise is granted.

KALISPELL, MONT.—The Mission Range Power Company has been granted right of way from the mountains east of Polson to Polson. The company has an hydroelectric plant which will supply Polson and neighboring towns with light and power.

WENATCHEE, WASH.—A survey is being made for a new power line of the Wenatchee Valley Gas & Electric Company running from the Dryden power plant to Wenatchee. Larger poles and heavier wire will be used in building the new line. The estimated cost of the improvement is \$20,000. The new line will carry 33,000 volts.

PORT TOWNSEND, WASH.—Definite steps were taken by the city council toward the purchase of the Key City Light & Power Company's plant, when the city council instructed the city attorney to prepare an ordinance to submit the matter to the vote of the people. The company has agreed to sell the plant for \$75,000 with \$10,000 in cash and the remainder in bonds.

TELEPHONE AND TELEGRAPH.

DINUBA, CAL.—The Orosi Rural Telephone Company has appointed a committee to incorporate the company on a non-profit-sharing basis. A new telephone line will be built between Dinuba and Orosi.

COLTON, CAL.—Only one bid was received for the telephone and telegraph franchise advertised. It was from the Pacific Telephone & Telegraph Company, and that company was awarded the franchise.

STANWOOD, WASH.—The Cedarhome Farmers Telephone Company is rebuilding its system from a ground system to a metallic system. It will have 120 miles of aerial wire covering Snohomish and Skagit counties.

ALTURAS, CAL.—Jules Alexander, one of the owners of the Nevada-California-Oregon Telephone & Telegraph Company announce that a new up-to-date telephone line will be built next spring from Fall River to Alturas by way of Lookout, Adin and Canby.

SIDNEY, MONT.—The Moore Telephone Company will start at once on the construction of a telephone system from Sidney to Sioux Pass, taking in Bronson and Girard. A new exchange has been ordered for Lambert which will be an underground cable system. Next year the line will be extended from Enid to Circle via Terrace and Vida, and another line will be built from Terrace to Wolf Point. Heavy construction and extension work will be done at Sidney, Fairview and Savage.

SAN FRANCISCO, CAL.—N. N. Winter of Hood River, who has been here for some time, is working on plans to merge the existing independent telephone lines in the Northwest into a \$2,000,000 concern. Among the companies that are expected to go in the merger are those at Hood River, White Salmon, Goldendale, Snohomish, Everett Sedro Woolley and Anacortes. Winter proposes to organize a company under the laws of the State of Washington, having an authorized capitalization of \$200,000 in stock, with \$1,350,000 of first mortgage 6 per cent 20 year bonds and \$650,000 of second mortgage 5 per cent 20 year bonds. The P. S. I. T. was formerly the Farmers' Mutual Independent Telephone Company serving the rural districts of Snohomish County. When it reorganized and took over a number of smaller lines it changed its name. Winslow, the general manager, makes his home in Seattle.

TRANSPORTATION.

SAN FRANCISCO, CAL.—The board of public works has authorized the city engineer to purchase the necessary anchor rails for the Church Street Municipal Railway line.

SAN BERNARDINO, CAL.—Work on the interlocking tower to be erected on New Magnolia avenue at the intersection of the Pacific Electric and Salt Lake tracks, will begin at once.

LOS ANGELES, CAL.—The construction of the elevated track from the Pacific Electric Building east to San Pedro street will begin within ninety days, according to Paul Shoup, president.

SANTA ANA, CAL.—A tower is to be erected at the crossing of the Santa Fe and Pacific Electric at Orange, near Santiago Creek and derailing tracks will be laid so collisions may be prevented.

SEATTLE, WASH.—The Seattle, Renton & Southern Railroad, an independent traction line which has been in the hands of the receivers for some time has at last been ordered by the court to be sold.

LOS ANGELES, CAL.—Eight of the fifteen new solid steel Pullman coaches ordered by the Pacific Electric Railway for the Covina line were put into service last week. These electric cars comprise the last word in car construction. Every car is inclosed, the smoking section upholstered, and the entire effect is very similar to the standard Pullman in use on the steam railways.

WATERWORKS.

RIDGEFIELD, WASH.—Bids will be received by the city council until January 18th for the construction of a 200,000 gallon reservoir, a pumping main, distributing mains, etc.

SAN FRANCISCO, CAL.—The board of supervisors will receive bids up to January 17th for the purchase of municipal water bonds in the sum of \$2,000,000. The bonds bear interest of 4½ per cent, payable semi-annually.

LA MESA SPRINGS, CAL.—The contract between the city board of trustees and the W. D. Hall Company for the construction of the water system in El Cajon has been signed by both parties and work will begin at once.

IDAHO FALLS, IDAHO.—The trustees of the village of Ucon have applied for a certificate of public convenience for the installation of a water system for the village. The village voted a \$5000 bond issue for that purpose.

SANTA MARIA, CAL.—The city trustees and officials of the Domestic Water Company have come to an understanding relative to the bond proposition and the city will soon vote on bonds for \$72,500 for the purchase of the system.

WAITSBURG, WASH.—The city is planning to get a better water system. The present supply is not satisfactory and officials expect to go higher up the Coppei and get a supply on a gravity system. A bond issue will be voted in the spring.

SALEM, ORE.—An order has been issued by the public service commission directing the Coos Bay Water Company to construct a reservoir of a minimum storage capacity of 250,000 gallons in connection with its water system at North Bend.

BAKER CITY, ORE.—Bids will be received by the city clerk until January 17th for the purchase of \$75,000 of the waterworks bonds, the bonds to be issued in denominations of \$500 each, payable 20 years from date and bearing 5 per cent interest.

SAN RAFAEL, CAL.—Delay in commencing construction on the Marin municipal water system has been occasioned by the lack of bids for the \$300,000 block of bonds offered for sale by the directors. General Manager Augustine explains the failure of the bond houses to bid by saying that they had not been given sufficient time to pass upon the legality of the proceedings. The directors, Augustine says, will readvertise the \$300,000 block for sale on January 18th.

MERCED, CAL.—Plans have been finally approved by the management of the Crocker-Huffman Land & Water Company for substantial improvements in its reservoir system, which will consist in isolating the Lake Yosemite reservoir from the irrigation canal system, reserving the water in the lake for drinking purposes solely. At present, the lake is the storage place for all the water brought from the Merced River to be used for both the city water supply and farm irrigation purposes. By constructing a new aqueduct three miles long, following the course of the shore of the lake on the north side for that distance, connecting thereby the present inlet canal with the outlet canal of the lake, it will be possible to isolate the lake water from the supply intended for irrigation use.

WOODLAND, CAL.—The board of trustees have decided to submit as soon as possible the question of bonds for the extension of the water mains system of the city and the construction of a full water plant, with tank at the Grand street auxiliary plant as it now exists. To carry out the plan as outlined by City Engineer Arnold, it will be necessary to raise about \$45,000. The report of the engineer contemplates two new wells, a 10 inch high pressure pump, a 150 horsepower electric motor, a 120,000 gallon steel tank to be 100 feet from the ground and the necessary accessories, the estimated cost to be \$12,476. It is proposed to lay 50 feet of 12 inch pipe on Grand avenue, and 1200 feet of the same size on Lincoln avenue. Pipe eight inches in diameter and four inches in diameter will be laid in other streets.

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SAN FRANCISCO'S ELECTRICAL FIRE PROTECTION SYSTEM.

BY JOHN CARRELL.

AVAILABLE POWER FOR COLUMBIA RIVER PROJECT.

BY L. F. HARZA.

DIESEL ENGINE PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

THE SNOWFLAKE IN INDUSTRY.

BY BENJ. F. PEARSON.

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SAN FRANCISCO'S ELECTRICAL FIRE PROTECTION

BY JOHN CARRELL

(Seldom has the means whereby a modern city is protected against fire been more interestingly described than in this article. It includes a description of the new central fire alarm station and gives all details of construction and operation. The author is electrical inspector with the San Francisco Department of Electricity.—The Editor.)

After San Francisco's great conflagration of 1906 had spent itself a crew of electrical workers salvaged the circuits in the unburned district and continued them to a temporary central station converted from an existing residence building. Later, when the recon-

building materials precluded the tearing up of the streets. In time, the financial aspect and other conditions became favorable and towards the close of 1915 the major part of the underground work had been finished, and the permanent central station, the



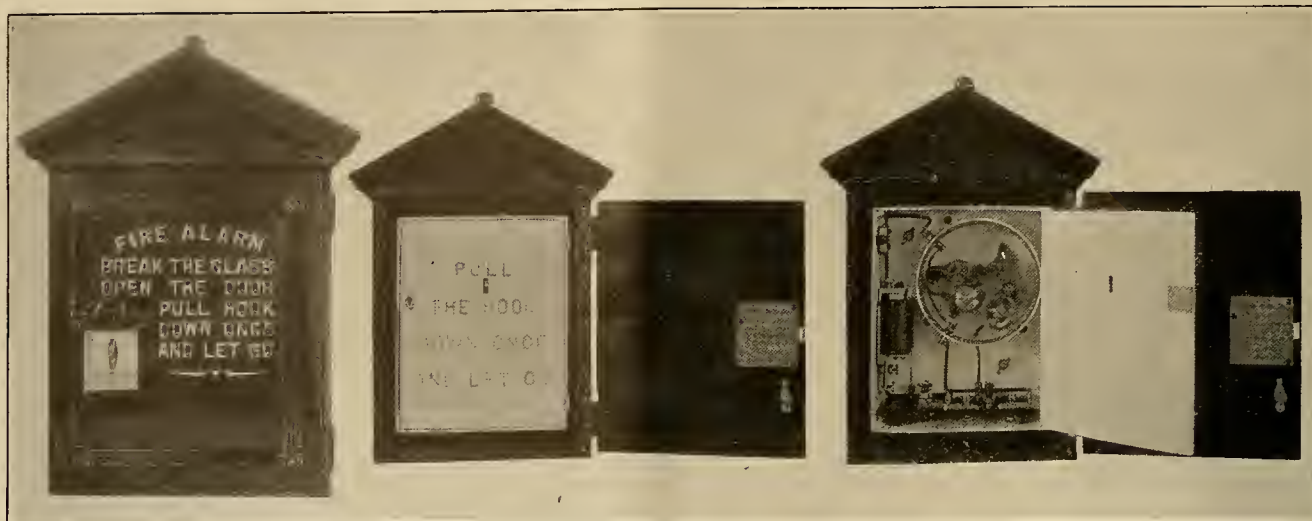
San Francisco's Central Fire Alarm Station.

struction of the city assumed a definite course, a semi-permanent station of brick was erected somewhat closer to the central business district, near the site occupied by the present civic center. The first fire alarm lines installed in the newly built section, although constructed of the best materials available at the time, were overhead lines of a temporary character.

Early fire protection plans had included a permanent central station and an underground wiring system, but the execution thereof was delayed by scarcity of public funds and the fact that enormous traffic in

final adjunct of an elaborate fire protection system, was completed and in service.

San Francisco is well protected from fire by (1) an adequate water supply system; (2) a trained and intelligent force of fire-fighters; (3) the most modern and effective portable fire-fighting equipment, and (4) a rapid, accurate and convenient method of transmitting both the intelligence which gives notice of the existence of a fire and the signals by which the fire department govern their movements during either normal or complex conditions. By these four dimensions the efficiency of a fire department is measured and



Typical Fire Alarm Box.

this paper will deal principally with the fourth dimension of San Francisco's fire department.

How the Department is Called.

Fire alarm boxes are placed at frequent intervals throughout the city, being mounted upon special standards or on street service poles and connected to the central station by means of an electric circuit.

The modern fire alarm box is of compact design. The door may be opened by breaking a small glass panel covering the latch. Just inside the door a small lever protrudes through the inner case upon which are the instructions "Pull down hook once and let go." The "hook" releases clock-like mechanism which rotates a character-wheel, or disk, having a series of uniform depressions in the rim; the depressions permit motion in, a movable piece pressing against the rim, which motion opens and closes the circuit in a certain order so as to indicate a number. Also within the box, but accessible only to department employees, is a telegraph key and sounder.

Each box circuit is normally closed, i.e., current is flowing constantly, except during the breaks of a contactor, and the same circuit wire loops through the contactors of fifteen fire alarm boxes, average; thence both ends of the loop enter the central station and pass to the source of current supply through the necessary apparatus on the switchboard, chief among which are a telegraph key, or manual contacting device, and a relay, or small electro-magnet which operates the contacts of a second circuit simultaneously with the contacting at the fire alarm box. This separate or local circuit operates a telegraph sounder; starts a register, or contrivance which records dots and dashes on a paper ribbon passed under a magnetically operated pen; causes a lamp to flash the signal; and locks contacts which illuminate a transparent number list of the boxes on the circuit. These audible and visual devices are calculated to impress the eye and ear of the station operator with the box number at which the "hook" was "pulled." The character wheel repeats its message four times.

Other circuits extend from the central station to the individual stations, i.e., engine houses, valve stations, pumping plants, fire boats, etc., over which the make and break process is quickly repeated in the

same sequence as indicated from the fire alarm box. To insure continuity these circuits are installed in duplicate, termed the "tapper" lines and "alarm" lines, and each set connects in series to an average of ten individual stations.

In the individual station a local circuit equipment, when contacted by a relay in the tapper line, causes the signal to be tapped on a large single stroke bell; operates a register; turns on the incandescent lights at night and where horse drawn vehicles are still used, magnetically releases the horses. The contacting of the alarm relay causes the signal to be confirmed on a smaller single stroke bell but operates no other device except the register.

The signal is repeated four times, twice on the tapper lines and twice on the alarm lines. The alarm lines are utilized independently to transmit signals which are essential to the operation of the fire department but which are not prime calls, i.e., which do not call units to a fire.

The firemen are literally off at the tap of the bell. The first alarm calls a certain number of the nearest companies. The senior officer of the answering detail may repair to the fire alarm box and by means of the telegraph key and sounder located within an inner compartment, call additional units to the fire or command the attendants of the high pressure water system and other auxiliaries through medium of the central station. Each chief is provided with one man whose principal duty is to remain at the fire alarm box and transmit orders sent from the scene of action.

All movements for each unit of the fire department, as well as for the auxiliaries, are pre-arranged and charted for every possible known condition. Each of the eighty companies is furnished with these charts in card index form and, in addition, a changeable chart or record-board, by which to record the units in and out of service and their positions. When a serious fire summons many companies from the surrounding districts, the companies still farther out systematically cover in to the vacated quarters of those in action in order to be more strategically situated in case of a general alarm or concurrent fire. Companies report "in service" on returning from a fire over a private telephone exchange; they also report out of service by the same means when accident or other condition



Half of Main Switchboard Room, showing Semi-Circular Board.

renders them temporarily unable to answer an alarm. The central station operators transmit all this necessary information to the fire department houses over the alarm circuits by means of a special code.

Auxiliary Alarm Circuits.

In order to work both ends to the middle it will be necessary to mention certain additional circuits. Firemen, like other public servants of high and low degree, must eat and leave quarters for the purpose, but are subject to recall; daily papers, some insurance institutions, etc., desire to receive all prime signals. It will be readily seen that a relay properly connected in circuit will transfer its signal to a second circuit, which second circuit may be relayed to a third and so ad infinitum. Each engine house has a relay circuit with separate primary battery, termed the "outside" local, which extends to the homes of firemen in the vicinity and to any other place where the installation costs and a nominal rental is paid.

There is a commercial firm which installs auxiliary fire alarm boxes in building wherever desired, from which points alarms may be turned in, thus saving the time necessary to travel to the street intersection. The auxiliary box circuit is provided with its own current source and is connected to a small auxiliary magnet in the municipal fire alarm box, which magnet, when properly energized releases the character wheel mechanism in the same manner as will pulling down the hook.

Still another commercial firm maintains auxiliary alarm posts in buildings, but carry the circuits into their own central stations, communicating the exact location of fires to the central fire alarm station by both telephone and telegraph.

A series of crossing signals warn street traffic when fire fighting units must cross the main thoroughfare of the city at high speed. These signals consist of large gongs and red lights mounted on special standards. A circuit from the central station operates a remote control switch in a down town engine house and closes a 220 volt multiple circuit to which the crossing signals are connected.

Central Fire Alarm Station.

The new permanent central fire alarm station is in Jefferson square, a public park of the residential section near the center of property valuation, and is

immune from liability of fire due to external causes, the nearest buildings being more than 300 ft. away.

The building is of an artistic design, compatible with its beautiful surroundings; is one-story in height with a basement and has a total floor space of 8500 sq. ft., nearly; was designed for and is used exclusively to house the central station apparatus; is of steel frame, reinforced concrete construction, and, as no wood is used even for floors, doors or windows, instrument cases or the like, there is no liability of fire due to internal causes. To be absolutely certain on the latter point a liberal supply of hand fire extinguishers are distributed about the building. The upper story is occupied by the main switchboard room, the private telephone exchange and several small rooms for convenience of the operators; the basement by a battery room, emergency power plant, cable rack and a dormitory with dressing room, shower bath, etc., for use by the night line trouble detail.

The switchboard room is 48 by 64 ft. in horizontal dimensions and 16 ft. ceiling height, with walls and ceilings plastered and ornamented with coves and mouldings. The floor is covered with heavy linoleum. An even light is diffused throughout the room by means of clear glass skylights set above a plane of maze pattern wire glass which forms a large part of the ceiling. Artificial light is furnished from semi-direct bowl type fixtures and by an emergency set of lamps equipped with reflectors of clear prismatic glass and placed as a border around the glass portion of the ceiling. Heat is furnished by a hot water circulating system and fresh air distributed by means of wall vents and ceiling openings.

The switchboard is of marble; is 8 ft. in height, and is arranged in a semi-circle of 29 ft. radius. Its form includes an offset to provide a bench 18 in. deep and 3 ft. high, upon which to mount apparatus adapted to a horizontal surface. The base of the board is of verdi antique marble from which rises the face of the bench in white statuary marble; the horizontal slab and vertical panels are of blue Vermont and above the vertical panels runs a moulding of beautiful Sienna. The two terminals of the semi-circle abut the front wall of the room, between which terminals the wall is treated with a similar arrangement of marble in harmony with the board, forming an enclosure which will satisfy the most critical eye. In the center

of the room is an elegantly carved marble desk equipped with apparatus for master selection and control of all prime circuits and essential auxiliaries.

In the space back of the switchboard are several additional bench boards and vertical panels on which are mounted diminutive dynamotors, motor-generators and battery charging control apparatus. One panel is devoted to switches controlling commercial light and power circuits which enter the building. Doors are inserted in the main switchboard at intervals.

The switchboard is equipped with apparatus for 45 signal circuits, 8 tapper and 8 alarm circuits, separately grouped. A fourth group of circuit apparatus, termed the "hospital," is arranged for the nursing and special treatment of circuits subject to electrical troubles.

All circuits enter the building through lead covered cables which pass from a pit in the center of the basement to a cross-connecting terminal rack directly above. Thence the circuits connect to station cables and pass over a metal runway suspended from the basement ceiling to the several panels where each circuit connects to the center contacts of a vertically mounted two-blade, double throw knife switch. This switch, when thrown up, connects the circuit to its respective apparatus on the board, but when thrown down transfers it to the hospital. After leaving the upper contacts of the double throw switches, all circuits in common pass through $\frac{1}{2}$ amp. 2500 volt fuses and vacuum tube arresters to the contacts of a ground test switch by which either side of the line may be connected through a volt meter to the ground; but from thence the apparatus differs for the box signal circuits and for the tapper and alarm class of circuits.

In fire alarm and similar work the right side of the circuit, as you face the panel, is termed the E (east) side of the line; the other the W (west) side.

The box signal circuits, after leaving the devices mentioned as common to all circuits: the W side passes through a milliammeter; thence through the coils of a 150 ohm relay; thence through a switch by which to throw in or out of circuit a resistance equal to that of a fire alarm box telegraph sounder; thence to the central control desk, through a closed circuit receptacle, or jack, and back to the panel, thence through a closed circuit telegraph key, and to one center contact of a two-blade, double-throw knife switch, which connects to the normal current source or to a spare source. The E side passes through a duplicate relay; thence through a current adjusting rheostat and through a duplicate telegraph key to the other center contact of the current supply switch. On the panel the two relays are mounted in the same frame and the keys parallel. The equipment of four such circuits, with appurtenant devices, comprise a switchboard panel.

The normal current supply for the box signal circuits is a 60 watt, 70 volt dynamotor, or machine in which the armature of a generator and motor revolve in the same field, one machine for every panel. The spare source is a battery common to all circuits and is used for individual test. Current on each signal circuit is maintained at about 100 milli-amperes.

The function of the relays and the audible and visual devices they cause to operate have been pre-

viously mentioned; but the local circuit which energizes these appurtenant devices is from a separate 16 volt source and is not connected to the main line equipment except at the secondary contacts of the relays. The secondary apparatus includes a small two-throw lever switch by which the audible devices may be silenced, either singly or for the entire board; also a set of push buttons will turn out the lamps behind the transparent box number lists.

The tapper circuits are more diversified than the box signal circuits, which is fortunate as the current of human interest suffers quite a drop in potential after passing consecutively through the varied devices which comprise a complete cycle of duty.

Apparatus of four tapper circuits constitute a tapper panel and includes an eight-pole double-throw relay having two sets of stationary contacts and a movable set. The coils which operate this relay are connected in series with a master telegraph key on the central desk. Each tapper circuit, after leaving the devices common to all circuits, pass through a resistance balancing rheostat on the W side and a 20 ohm relay on the E side, thence both sides terminate on two of the movable contacts of the striking relay. When a signal is being struck out the movable contacts are successively pressed against the upper stationary ones and send out pulsations from a 220 volt current source which is sufficient to operate the engine house relays and notifies the fire fighters on watch; but, when at rest, the striking relay connects each circuit through a highly sensitive 500 ohm relay, a milli-ammeter and knife switch to a supply source adjusted at 20 milli-amperes, a current too feeble to affect the individual station relays but ample to hold up the armature of the sensitive 500 ohm relay, thus maintaining a constant test for accidental breaks in the circuit wire. The upper contacts of the striking relay are alive only during the signaling period and the feeble current is disconnected during that time. This switching operation is performed by remote control switches elsewhere on the board but also manipulated from the central desk. A separate 60 watt, 30 volt motor-generator supplies closed test current to each panel. Also there is a spare source for individual test. The local circuit for the tapper panel operates a register when contacted by the 20 ohm relay and causes a lamp to glow behind a transparent number list of individual stations when contacted by the 500 ohm relay.

The alarm circuit panels and striking equipment are separate from the tapper panels but are exact duplicates thereof.

The current which supplies both tapper and alarm equipment with 220 volt striking current is carried to the control desk where it may be connected either to a commercial source or to an emergency 1 kw. motor driven generator, operated either from a commercial source or a 120 volt storage battery.

There are two operators on duty at all times, termed the relay operator, who takes care of incoming business, and the key operator who handles all outgoing calls. The post of the key operator is the central control desk where he is the master of all he sur-

veys or the servant, as the case may be. By inserting a plug in the proper jack he can cut in a telegraph equipment on any signal circuit. His local circuit equipment provides control of sounders, number lists, etc., and includes a master register for each class of circuits. He can also be connected by telephone to all the individual stations over a private exchange.

Hospital Panels.

When a circuit is out of working condition it is transferred to the hospital. The transfer circuit terminates in a receptacle on a panel devoted to jacks. The hospital circuit terminates in a plug in front of the jack panel. Hospital panels are similar to the other panels for the respective classes of circuits but



Generator Room.

are supplemented with apparatus by which troubled circuits may be isolated, tested, provided with an individual current source and nursed until normal conditions are restored. When a plug is raised from its position on the bench the motion permits a switch to close which starts an individual motor-generator set to supply current to the troubled line, and when the plug is properly inserted, the hospital is working. Tapper and alarm hospital circuits are each provided with two small motor-generator sets, one for closed test and one which supplies 220 volt striking current.

The most common of troubles are open circuits, grounds, and occasionally the presence of foreign currents. Circuits afflicted with grounds or foreign current troubles may be usually kept working when supplied from a separate current source. An open box signal circuit is a serious matter and when this occurs the operators connect one pole of the current source to the ground and the other pole to both sides of the circuit and then request department employees to close in along the circuit route to signal through the ground from certain boxes. A ground switch is closed in the two boxes adjacent to the break, thus bridging the circuit until the repair detail can correct the trouble.

In case of an open tapper or alarm circuit the operators by telephone direct the manipulation of switches in the individual stations to discover and to bridge the break through the ground, pending repairs.

Current Supply.

A constant electric power supply to operate the central station is a vital item. Service circuit from four different commercial sources enter the station, two of which are direct current and two alternating; but to provide against failure of all these, the station is equipped with a $7\frac{1}{2}$ kw., 120 volt, d.c. generator. There are also two 120 volt storage batteries each of 280 ampere hour capacity.

All motor-generators and dynamotors which supply current to the main line circuits are normally driven by 120 volts direct current from either commercial source. A storage battery is connected to this circuit but does no work except during failure of the



Battery Room.

source; i.e., when the supply source drops below a minimum pressure it is disconnected by an automatic switching arrangement and the battery carries the station. One storage battery is held in reserve.

Storage battery charging may be effected from a commercial source, in which case 220 volts are applied through a current limiting device or from a d.c. generator driven from either of two motors. One motor causes alternating current power to be translated into direct; the other may be operated from any direct current source, this latter arrangement tending to secure a steady current from a less stable one. Push button control from the operating room is provided to operate the generator.

The 16 volt current for local circuits is secured from taps to the 280 ampere hour batteries.

As a precaution against possible explosion from the gasoline engine equipment and the gas appurtenances of the hot-water heating system, these appliances, with the larger motor-generator sets, are placed in a basement room separated from the rest of the building by heavy concrete partitions.

Character plays an important part in fire alarm work: to have absolutely automatic character wheel mechanism by which the citizen or non-expert may call the department and to have the system in charge of expert men of known judgment and ability. From this point of view the San Francisco system was designed.

Many central fire alarm stations are provided with automatic or semi-automatic means by which to transmit calls to the engine houses. The San Francisco system is manually operated, the designers believing the automatic method the slower one and that where automatic operation does not save time it is inferior to manual operation by experts. However, provision has been made for the future addition of an automatic transmitter if desired.

The fire alarm boxes in general use are plain boxes, so called in contradistinction to certain patented and elaborated types. All vicinity boxes are connected to different circuits, i.e., the circuits are interlaced. This feature is designed for multiplicate protection and to prevent two boxes of the same circuit from being pulled simultaneously by persons starting in opposite directions from the same fire.



Typical Station House Equipment.

A machine shop, equipped to manufacture and repair signalling apparatus, and a small garage are maintained by the department in charge of the fire alarm system, but are housed in a separate brick building several blocks from the central station. The shop manufactured most of the switchboard apparatus for the new station and is now constructing new fire alarm standards for use with the underground cable system. This standard is of beautiful design executed in cast metal and comprises a fire alarm box head-piece mounted on a square post, or casing. One distinctive feature is the position of the small glass panel directly over the hook, this simplifying the procedure of turning in an alarm. The hollow post is provided with a door and is designed to hold battery for auxiliary box circuits.

The installation of electrical equipment of the new central fire alarm station, a project which required correlations of the work of many men, was made by James M. Barry, chief department of electricity; Paul J. Ost, chief electrical assistant to City Engineer M. M. O'Shaughnessy, was in charge of electrical design. A. Lacy Worswick, chief draughtsman board of architecture, designed the building. R. W. Wiley, superintended the electrical construction and to him must be given credit for many of the refinements of operation embraced by the new installation. Frank Ichoff, shop foreman, department of electricity, supervised the construction of switchboard apparatus.

DIESEL ENGINE PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

Life of the Diesel.

The life of a Diesel engine is something that is often discussed. It is not unusual to find steam engines and steam pumps which have been in service thirty years, maintained in fair state of up-keep by repairs and renewals. The frame, shaft, flywheel and foundation, representing a large part of their original cost, continue in service. Yet, the engine and pumps represent less than forty per cent of the cost of a steam installation—about sixty per cent being in the boilers, heaters, condensers, stack and piping. Some of these features, the boilers notably, each year show a marked deterioration and loss in efficiency. None of these features exist in the Diesel, and its life will compare most favorably with the entire equipment of a steam plant, its efficiency throughout its life remaining practically unimpaired.

The story of the Diesel engine is quite different from that of gradual obsolescence of the old steam plant. Ten, even fifteen years ago, when the Diesel was first built, it showed the same extraordinary efficiency. No builder of Diesels abroad, nor do we here, expect to increase its thermal efficiency to a very great extent. Diesel progress has been one of increasing refinements, a lengthening of its life, an increasing of its reliability and facility in handling and a perfection of its governing under varying loads. In these it is unapproached by any other type of prime mover.

The heavily designed frame, the shaft, and connecting rods, the massive fly wheel, etc., form a much larger proportionate cost of Diesel equipment than do these parts in a steam installation. Since these non-wearing parts form the larger cost, those parts which wear and deteriorate most, of necessity, form a less proportionate part of Diesel equipment than they do of steam equipment. It is easy to realize this by recalling that the entire boiler equipment, with all its auxiliaries, is eliminated, and that wear and tear is confined to parts which represent less than one-third of the original Diesel investment.

In the steam engine and in all explosive and hot-bulb types of internal combustion engines, leaky valves and worn cylinders result in reduced efficiency, the cause of which is not always apparent. If the engine is not loaded to capacity this consequently may not be detected until much damage has been done and much money lost. The Diesel, depending upon perfect compression for its ignition, does not permit a continuance of such losses; if compression fails ignition ceases and the engine stops. In other words such conditions as militate against the life of engines and their economy absolutely cannot exist long enough in the Diesel to do serious damage, or consume fuel in useless effort.

Another feature of the Diesel which adds to its life, and which sets the Diesel apart from all explosive types, is the absence of any sudden rise in pressure at instant of combustion. Gradual introduction of fuel during ten per cent to twelve per cent of the combustion stroke results in a more uniform stress and longer life.

Two 225 h.p. Diesel engines in a Texas power

house during the nine years since they were installed, have operated on an average eighteen hours per day. Their cylinders were rebored after nine years' service. With the same handling in the future as they have had in the past, they should outlive a steam plant of like capacity.

With late designs, the wear and tear on the operating parts will be much less than in the older design. In the first engines, the cylinders were solid, so that in five or six years, as they became worn, it was necessary to bore them out and purchase new pistons. In the later designs the cylinders are fitted with a liner so that they may be replaced by merely lifting them out and slipping new ones in their place. These liners are made of cast iron and require only a small amount of machine work, so naturally are not expensive—simply a case of cast iron at so much a pound. With this system, new pistons are not required, as the piston of a Diesel engine never wears, simply the rings and the cylinder walls.

Reliability.

The reliability of the Diesel engine has been doubted for many years, not from the performance of the engine itself but from false reports. However, judging from the experience of the numerous plants that have been in continuous operation, they have proven very successful.

The water pumping station at Sherman, Texas, owned by the city, is a fair example. This is an installation of two 170 h.p. engines which for the past four years have been operating continuously 24 hours a day on 30 day runs. At the end of this time the engines are shut down, inspected and adjustments made if they are required.

There are any number of plants that have but one engine used for city lighting service and in manufacturing industries. If the engines in either case are operated on 24 hour schedule they arrange to shut down for a few hours on Sunday for inspection.

The City of Donaldsonville, Louisiana, purchased two 170 h.p. Diesels in about 1912. These engines furnished the light and the power for the city water works system. While a great many cities in the south have a standpipe in connection with their water service, Donaldsonville pumps directly into their lines, the pumps being driven with motors operated automatically to hold 50 lb. pressure on the system. The reliability of the Diesel engines in this plant was highly endorsed by the Fire Underwriters and the plant shows a wonderful saving over their old steam plant. The steam plant used 32 barrels of oil in 24 hours or 90 barrels of coal, while the Diesel plant, with practically the same load, uses $3\frac{1}{2}$ barrels of oil per 24 hours, a saving of between \$1000 and \$1100 a month in fuel for the city.

The Texas & Pacific Railroad Company operate two of their railroad shops with Diesel engines, one at Marshall, Texas, the other at Big Springs, Texas. The Marshall engine has been operating a number of years, and judging from reports received from their mechanical engineer, this engine is giving perfect satisfaction, not only in the extreme economy of operation, but wonderful economy in upkeep. They state that their engine

consumes 8 gallons of fuel per hour with an output of 90 kw., also that the average upkeep of the engine for the past three years has not been more than \$2 a month—their engineer knows his business! The engine in the shops at Big Springs has been operating over two years with perfect success and little upkeep.

Another marvelous example of the reliability of the Diesel engine, both for endurance and upkeep, is at Plant City, Florida. This engine furnishes the lights for the city, in connection with furnishing power for manufacturing ice. The engine is 120 h.p. and was operated almost continuously for three years before any repairs were made. When the engine was overhauled the writer was there to note its condition and found out of eighteen rings, only two piston rings broken on the three pistons. None were stuck, and the cylinders were in perfect condition, as smooth as a looking glass. When the reliability for continuous operation is questioned it is safe to state that the Diesel engine is fully as dependable, if not more so, than the steam plant, when upkeep of boilers, pumps and auxiliaries is considered.

The City of Lyndon, Kansas, was operating a modern steam engine, in excellent condition, in fact when it was sold second hand it brought nearly full price. While operating the steam engine they only ran from dusk to dawn. Their average oil consumption was 1 bbl. of oil per hour; if they ran 10 hours it was 10 bbl.; if 13 hours 13 bbl., etc. The city installed a 120 h.p. Diesel engine three years ago, turned around the generator which had been belted to the steam engine and belted it to the Diesel. The load has been increased by extra street lamps and new residence users and storekeepers, but even with the increase of output the Diesel engine does not average a barrel of oil per night, figuring 365 days a year. Naturally they are highly pleased and are now considering the purchase of another Diesel and furnishing lights and power for small surrounding towns.

The longest run the writer can recall was 94 days continuous operation in Jerome, Arizona. The plant consisted of two 225 h.p. Diesel engines connected to a Root blower with rope drive, ventilating a mine. This we consider "going some" for combustion engines, and they were operated on California fuel oil containing 25 per cent asphalt.

Another Diesel plant at Coeymans, N. Y., furnishes the light and power for three towns, namely, Coeymans, Ravina and New Baltimore. It has been in operation for the past seven years and the owner stated on several occasions, when asked what he thought of Diesel engines, that if he had his choice of being presented with the best reciprocating steam plant that could be furnished, and he had to buy the fuel to run it, he would much rather pay the price for Diesel engines. This plant, without a doubt, is the cleanest and best kept Diesel plant in the United States. The first two engines installed were 120 h.p. Since that time they have purchased two more, one 120 h.p. and one 225 h.p., all direct connected to a.c. generators operating in parallel. These are simply instances of typical Diesel plants of which there are now over 400 in operation in this country.

THE SNOW-FLAKE IN INDUSTRY.

BY BENJAMIN F. PEARSON.

(This suggestive bit of poetic prose tells in a fitting manner of hydroelectric power's contribution to civilization. It was read before the Jovian Electric League of Southern California on Dec. 29, 1915, by the author, who is general superintendent of the Southern California Edison Co.—The Editor.)

In a recent poem, written by Mr. Charles Heston Pierson, snow was referred to as "The New White Coal," and I can not do better than preface my few remarks by reading it:

"Oh, peaks of the grand Sierras, that lift your heads so high
That the drifting snow of the winter clings 'neath a summer sky;
Oh, peaks of the High Sierras, where the fleecy cloud banks roll,
Do you know that the snow which you cherish is known as 'the new white coal?'"

Do you know that when it leaves you, trickling away in the sun,
That it goes on a mighty mission, and its task is just begun?
Do you know that when it leaves you, to course down your rugged sides

Forming the stream and the brooklet and the river's roaring tides,
That its rush is the power of the turbine, that generates the spark,
Which is carried away and away on the wire, dispelling the night and the dark;

That it drives the busy factory where once the chimney loomed;
And quiets the noisy engine that puffed and fretted and fumed;
That it cooks in the cottage kitchen; and warms where the family meet;

And does those things which coal did do when it was our light and heat?

Oh, peaks of the High Sierras, where the cloud banks softly roll,
Cherish the snow on your icy crests that is known as 'the new white coal.'"

The snow-flake, emblem of eternity, chastity, charity and better yet, an emblem of energy; it is the hand-maiden of industry; a spoke in the wheel of progress. Man is rapidly subduing and subjecting to his control, the forces of nature, and man today owes it to the man of a thousand years hence to contribute to the conservation of the natural sources of energy, and notwithstanding the future may demonstrate the successful harnessing of solar energy, and the limitless power of the tides, the problem of greatest moment are those in our immediate fore-ground. When one hundred years have rolled around and Mother Earth shall have disgorged her last ton of coal, and the last gallon of oil has been wrested from her embrace; when all the waterfalls and the current of the river shall do man's bidding in perpetual service, then may man look to the hills, "from whence cometh our strength," and thank this generation that in our wisdom we stayed the hand of the ruthless slayer of forest and woodland, halting devastation and deluge; in its place making the timber line sacred and the halting place for commerce, so that the snows of future centuries might find a resting place among the mighty pines, and only yield itself gently to the allurements of the summer sun, instead of plunging wildly down the mountain slopes, hand in hand with destruction. Then will there be added meaning to

"I love thy rocks and rills,

Thy woods and templed hills";

And the electrical industry is deeply interested, with every good citizen in the conservation of Nature's forces. Industry is demanding more and more of our

natural resources. Last year approximately 600,000,000 tons of coal were mined and consumed, and petroleum oil equal to about 27,000,000 tons. Nature gives us one hundred per cent, and notwithstanding the almost magical strides in electrical and mechanical engineering, less than three per cent of the fuel consumed finds its way to the incandescent lamp in the form of light.

We place a ton of fuel in the furnace and we deem ourselves fortunate to extract from it, through the medium of boiler, engine and dynamo, fifteen per cent; on the other hand, we drop one ton of melted snow on a water wheel and extract from it eighty per cent. At the present time the melting snows of a thousand hills are contributing to the delivery in centers of industry of 6,500,000 h.p., and waiting patiently the touch of the engineer, banker and artisan 45,000,000 h.p. is going to waste, equalling approximately 7,000,000,000 gallons of oil annually, or equal to the average total world's production of oil for thirty years.

The history of the evolution of industry is the history of the achievement of individuals, and while it is true that we have to give credit to the builder of 5000 years ago, for the greatest known monuments in architecture, and our standards in art date back 2000 years, yet the achievements of science only date back to yesterday.

Possessing all of the natural resources necessary in the development of every industry, it only remained for Yankee ingenuity to develop and build and master every art and science necessary to the progress and spirit of the age, until today America is recognized as the richest and greatest nation in the world, as well as the leader in industrial development.

The history of the past one hundred years reads like a fairy story, and forms a new Arabian Nights. Jefferson said it would be one thousand years before the Great Northwest could by any possibility be settled. He could not foresee the wonderful inventions that have united the North and South, East and West. The wildest visionary of fifty years ago would not have dared to prophesy those things which have become, not simply luxuries of modern life, but the actual necessities in the transaction of every-day business, and the greatest factor of all is the generation and transmission and use of electrical energy. If by some cataclysm of Nature, or some reversal of Nature's laws it were not possible for man to harness the magnetism of the poles, the world would immediately come to stand-still; the mighty ships of the sea, including all her navies and the subtle submarine, and transportation in almost every form, including no fewer than two million automobiles in use in the United States alone, would suddenly halt; aviation would cease; and the whole world would face ruin, and would have to begin again to solve the problems of existence, where we started fifty years ago. The smelter and the foundry, the machine shop, the textile factories; in fact every industry and avenue of trade would be paralyzed, and it is doubtful if the ingenuity of man could find any possible substitute.

If I were an artist, I would create a figure, representing electricity, standing with one foot on the North, and the other on the South Pole, reaching out

with one hand into space, taking hold of the powers of omnipotence, and with the other, reaching down and lifting humanities' burdens, and making possible the dream of the alchemist.

To the mind not trained in terms of electricity, and even to those whose minds are trained, the developments of even yesterday fill with wonder. When DeForest, in his investigations and experiments in the development of wireless telegraphy discovered what is now known as the Audion, making possible the transmission of sound over telephone wires between the Atlantic and Pacific states and making possible the transmission of sound without the medium of wire or conductor other than the atmosphere, it would seem as though he had performed the last act, linking humanity with infinity. As we hesitate a moment, and picture to ourselves the head of the United States Government, sitting in his chair in the City of Washington, talking into the telephone, speaking directly to the heads of government of every nation, kindred and tribe of the earth at the same time, it seems almost impossible, and beyond the ken of things we understand, yet the little instrument that makes this possible is not much larger than a full-grown incandescent lamp; in fact looks very much like one; so that notwithstanding the first transatlantic Marconigram was published in the Los Angeles Times March 30, 1908, the wonder of wonders now bows the knee and worships at the shrine of Wireless Telephony!

Step has followed step in such rapid succession in invention and in the industrial arts, that it is impossible, even with the most meager birds-eye view, to grasp what it all means. Within the memory of men living we have passed from the tread-mill to the modern dynamo, from the old spinning wheel to the modern loom, from the old hand press to the modern Hoe printing press, producing with more than human precision, 75,000 sixteen-page, multi-colored newspapers per hour, printed, folded and ready to mail; consuming a total length of 300 miles of paper.

It seems almost like a flight of the imagination when we consider the step from the prairie schooner of '49 to the modern monoplane capable of a speed of 140 miles per hour. It would consume hours to touch on the various distinguishing features in the progress of our age. It seems but a step back to the day of the old pine knot torch of our fathers, until now we accept without question, and without any investigation, the science that makes it possible for you or I to turn a switch and throw a beam of light no less than seven miles, sufficiently strong to enable our neighbor at that distance to read his evening paper!

In the United States alone the interests of public utility companies, engaged in selling electricity, total the sum of \$2,800,000,000; and in the telegraph and telephone business there is a total investment of \$2,094,000,000, requiring for the transmission of messages no less than 38,000,000 miles of wire.

It has been truly stated that the industry is young, and it is only a day or so since a few hardy pioneers of Southern California gathered in the little town of Redlands, and looking at the snow-capped mountains, wondered why it would not be possible to improve on the old water-wheel of the mill, and generate elec-

tricity. After patient investigation, backed by the determination to win, the snows of Mount San Bernardino, Greyback, and the range adjacent to them, were made to contribute their potential power to the necessities of the communities of Redlands, Riverside and Colton, and the first three-phase hydroelectric station was placed in operation in the year 1893, and in 1898 the most daring feat in electrical engineering was performed, when this same group of pioneers backed by the counsel, capital and co-operation of Mr. John B. Miller, president of the Southern California Edison Company, harnessed the streams of Bear Creek and Santa Ana, daring to presume to transmit power to the City of Los Angeles over wires, a distance of seventy-five miles; and it is interesting to note that many of the leading engineers in the electric industry, today, who were then young and who have since become great, prophesied failure. The fact, however, was accomplished, and Los Angeles was electrically connected to the drifting snow of Greyback.

During the nineteen years that have intervened this project has lost its place as one of the wonders of the engineering world, and we now wrest power from the snow-capped peaks of mountains two hundred and fifty miles away! Is it any wonder then that we have given some consideration to the "snow-flake" as a tremendous factor in industry, possessing as it does, aided by the skill of man, potential power which is eternal; not one flake but does not, at some time, reach the sea, and not one flake but that sooner or later is sent back on its mission, and again finds a resting place on some mountain peak, waiting its bidding, to pass on and carry with it life and health and power.

And what of the men who have made all these things possible, men who have devoted and consecrated their lives to scientific research, that you and I and our millions of brothers, and the generations that shall follow, might have all of the privileges of modern science ready to do our bidding at a moment's notice.

As we scan the horizon we see the towering figures of Edison, Graham Bell, DeForest, Tesla, Marconi, Sprague, and many others, who fought, not as seeing the reward, but in an unselfish endeavor to wrest from Nature some of her secrets and scatter the harvest broadcast. We reverently pay them homage, and it is not lightly that we refer to the words of that immortal American, Abraham Lincoln, when standing on the field of Gettysburg, he gave utterance to that wonderful eulogy, and said "We came here to dedicate a portion of that field as a final resting place for those who gave their lives, that this nation might live, but we cannot dedicate, we cannot consecrate, we cannot hallow this ground. The brave men, living and dead, who struggled here, have consecrated it, far above our poor power to add or detract."

The British thermal unit (B.t.u.) of heat energy is equivalent to 777.5 foot pounds of mechanical energy. It has also been largely adopted as 1/180 of the heat necessary to raise one pound of water from 32 to 212 degrees.

REPORT ON THE COLUMBIA RIVER POWER PROJECT.

Appendix E—Available Power.

BY L. F. HARZA.

The program of head control illustrated in Fig. 20, which was discussed in Appendix D chiefly from the standpoint of property damage from the backwater, first needs additional discussion with reference to the practicability of station operation under this program.

Turbine efficiencies and erosion. For best efficiency the speed of rotation of a turbine should change with every change in operating head. This is impossible when attached to an electrical generator without causing a change in frequency, and the speed must therefore be kept constant. The speed of a generating unit must be chosen for best efficiency at the normal head or the head under which it is to operate for the largest number of days per annum, the efficiency then falling off for both larger and smaller heads.

During the last ten years the science of hydraulic turbine design in the United States has undergone an unprecedented development, especially along the line of increase in speed, maximum efficiency and in efficient operation with wide range of variations in both gate openings and head. Several turbines have now been tested at Holyoke which have shown efficiencies of about 90 per cent or better. In at least one instance for the very high specific speed of 90, at which efficiency is much more difficult to obtain, an efficiency of 88 was secured; in another instance an efficiency of 91.5 per cent was secured at a specific speed of 64.0.

It has also been demonstrated that the Holyoke test offers, if not a satisfactory basis for closely predicting actual turbine efficiencies after installation, yet at least, a very satisfactory basis for comparison of relative efficiencies after installation. Tests after installation have also been assuring as to the practicability of safely using the Holyoke test of a small runner as a basis for the design of a much larger runner for operation under a much higher head such as would need to be done for this project. In fact, the efficiency in service has nearly always exceeded the efficiency of the small model runner at Holyoke.

Without going into detail regarding the test data it may be said that an analysis of the tests of several of the best runners submitted by several turbine builders has shown that reasonably efficient operation through a range of heads from 105 ft. down to 45 ft. is entirely practicable hydraulically and that turbine efficiencies can be realized of about 74 per cent at 45 ft. head, 86 per cent at 70 ft. head and 77 per cent at 105 ft. head, based upon a selection of speed for best efficiency at 70 ft. head and after subtracting about 3 per cent from the Holyoke test to allow for frequent operation at other than the best gate opening to serve a variable load and to affect the distribution of the load among the units. These efficiencies are not based upon the best of the tests submitted but are fairly representative.

The regular operation of the units through this wide range of heads is subject to two objections: The lowest efficiencies are obtained at the extremes in head and result in a sacrifice of station capacity at low water when efficiency is of greatest value; and necessitate

a larger canal, as well as more machinery and power house space, during low or flood heads.

The buckets of turbine runners are subject at times to a severe erosion or pitting which appears to increase with the amount that the runner is operated at other than normal head, or the head for which its speed is best adapted, especially higher heads. It also increases with the amount of operation at low gate opening. Its severity is further dependent upon the material of which the runner is constructed and upon the correctness of the design of the runner by which smooth flow of the water in parallel filaments and without violent agitation is secured.

The cause of this action has never been fully explained, or at least not generally agreed upon. The opinion may be ventured that violent agitation is the dominant cause and that the other causes above mentioned are effective chiefly insofar as they cause this agitation. The condition is believed to be in every way comparable with that discussed in the chapter on geology in explanation of the formation of the deep pool below the damsite. Any violent agitation of water passing over a surface, whether caused by a depression already existing in the surface, by a too rapid expansion, by the impact of the water against the buckets in entering, or other imperfection of the flow channel, causes the suspended particles of sediment in the water to be thrown violently against the surface in a truly sandblast manner, causing rapid erosion where smooth flow of water, even if full of sediment, would have comparatively little effect. In fact it is not unreasonable to expect that a violent action of this sort even with pure water might set up destructive molecular activity sufficient to cause this erosion. Based upon this theory and as shown by actual service, high efficiency in a turbine is believed to be, to a considerable extent, an insurance against severe action of this sort.

Choice of turbines. To minimize the danger of runner erosion and to obtain higher efficiencies at the extremes of head a scheme has been worked out by which two types of units would be used, one set to operate through a low range of heads, from minimum to about 85 ft. with best speed chosen for about 63 ft., and the other to operate chiefly through the upper range with best speed chosen for about 85 ft.

For the maintenance of the continuous or perennial power of the stream during a normal year, the high head units would not need to operate below a head of 70 ft. During the rare occasions, however, when the flow would exceed 700,000 second feet and the head drop below 50 ft. the high head turbines would again be brought into service. They would operate at an efficiency, at 45 ft. head, of only about 62 per cent, but their use would avoid the installation of additional low head units for these extremes. The length of time during which they would thus be operated at this low head would be too short and the occasions too rare to make the question of runner erosion of any importance. Using the scheme above outlined it is believed beyond question that operation throughout the entire proposed range of heads, and even a greater range if desirable, is entirely practicable.

The resultant curve of turbine efficiency platted from the Holyoke test data of a representative of each

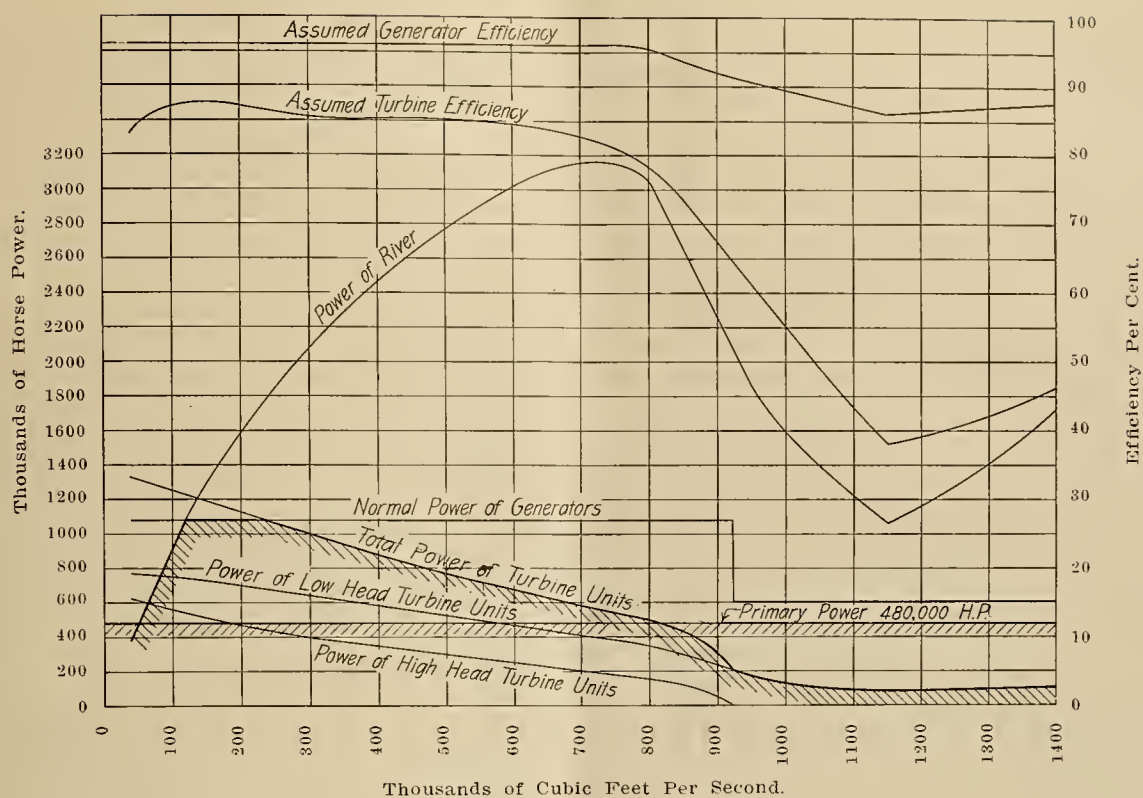


Fig. 23. Machine Efficiencies and Generating Capacities.

type of runners submitted by one of the manufacturers is shown in Fig. 23, after deducting 3 per cent as margin of safety from the results shown by the Holyoke test, and with full consideration of the distribution of load among the two sets of units, the load per unit of each set and corresponding efficiencies. It will be noted that the efficiency would vary from about 84 per cent at a flow of 50,000 second feet upward to 87 per cent at a flow of about 150,000 second feet and down again to 78 per cent at 800,000 second feet corresponding to a net head of 45 ft. For greater discharge the efficiency would fall off rapidly as shown to a minimum value of about 38 per cent as nearly as could be estimated by an extension of the curves of the Holyoke test to this point, which was beyond the range of the test data. These units will be more fully described in the chapter on "Power House and Equipment."

Generator efficiencies. In Fig. 23 it will be seen from the curve of assured generator efficiencies that a value of 96 per cent was assumed nearly throughout the normal range of flow of the river. The efficiency would actually vary, but the variation in any case would be too small to require detailed analysis for present purposes.

Power of the river at low water. In Fig. 23 is shown a curve representing the total power of the river if it were all used for power purposes with the above assumed turbine and generator efficiencies and according to the program of head control shown in Fig. 20.

A flow of 50,000 second feet has been assumed as the minimum for the purposes of this estimate. By reference to the hydrographs and to Fig. 24 it will be seen that the flow has fallen below this amount only

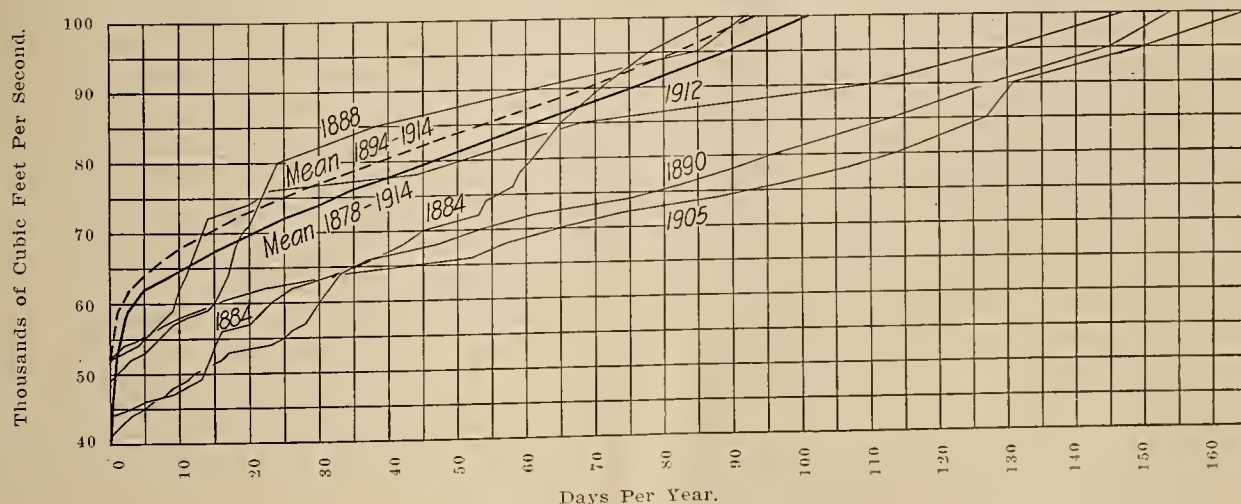


Fig. 24. Duration Curves of Mean and Extreme Annual Low Water Periods.

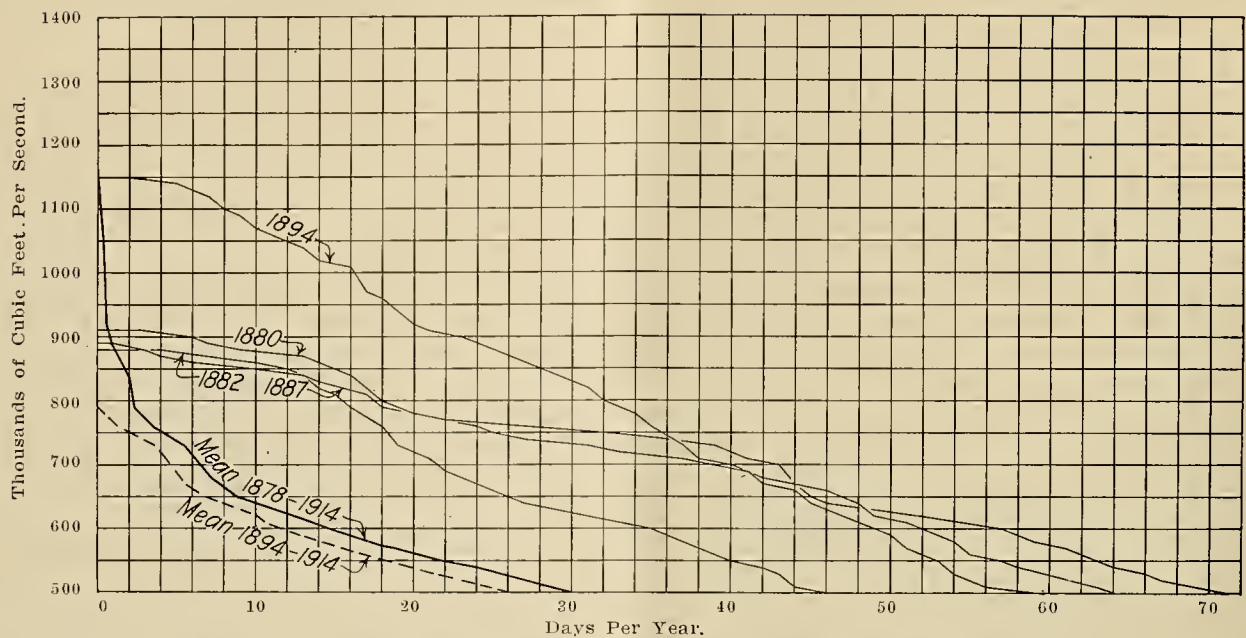


Fig. 25. Duration Curves of Mean and Extreme Annual High Water Periods.

three times in the thirty-six years of available records, the periods of deficiency being: 1884, 12 days; 1888, 1 day; 1890, 13 days.

During the past twenty years or since 1894 the flow has not fallen below 52,000 second feet. The deficiency below 50,000 second feet has had an average annual duration for the entire thirty-six years of $\frac{3}{4}$ day per year as computed from the above record of deficiencies and as shown by the heavy line in Fig. 24. The average duration, for the period since 1894, is also shown in the same figure by heavy dotted line.

Upon the showing of these curves one would under usual conditions be warranted in basing the capacity of the station upon an assumed minimum use of at least 55,000 second feet. The value of 50,000 second feet is chosen to allow for leakage through the rockfill dam if this type of dam be adopted, also for leakage through the flood control gates, water used for lockage by the Celilo Canal and for a fishway, inaccuracies in stream flow records, etc.

The power which could be delivered to a switch-board with a flow of 50,000 second feet, net head of 105 ft., turbine efficiency of 84 per cent and generator efficiency of 96 per cent, would be a little over 480,000 horsepower, or 360,000 kilowatts, which figure will be adopted as the usual minimum continuous low tension generating capacity of the power site when developed for the maximum practicable head as described.

Maintenance of power at high water. Since power is proportional to the product of water and head, a reduction in the latter which always accompanies high water must be made up by the use of more water, and this in turn requires a larger canal and the expense of more generating units, since the units will not under this condition consume even their former amount of water. The required increase in generating machinery without allowance for reduced efficiency, is indicated by the following table:

The minimum head which need be provided for depends upon its frequency and duration. It was shown in Appendix D that a flood of 800,000 second feet which accompanies a net head of 45 ft., and which

Actual Head.	Per cent of Normal Head.	Per cent of Normal Generating Equipment Required.
105	100	100
94.5	90	117
84	80	140
73.5	70	171
63	60	215
52.5	50	283
45	42.8	357
42	40	395
31.5	30	609
25	23.8	860

has been adopted as the flood limit of full station capacity, has a probable frequency, judging from the entire 57 years records, of once in five years, and that this flood has not been reached during the past twenty years. Daily discharge records extend back thirty-six years, and during that time this flood has been exceeded only four times. Duration curves of the flood seasons for those four years are shown in Fig. 25, also the mean curves of the thirty-six years and of the past twenty years. It will be noted that the duration of 800,000 second feet has been as follows:

1880.....18 days	1887.....17 days
1882.....16 days	1894.....32 days
Mean of 36 years.....2.3 days	
Mean of 20 years.....0.0 days	

The figures in the above tables indicate clearly the futility of trying to maintain full power for heads below 45 ft., and even the range of heads already adopted may at first be considered excessive. It must be remembered, however, that the minimum head of 45 ft. is fixed by natural conditions and any change of the range of operation would need to be made by a reduction of the maximum head of 105 ft. and consequently of the station capacity. The machine equipment must be chosen for the low head of 45 ft. A given increase in maximum head, causing a proportionate increase in station capacity, would therefore only increase the number of generating units in the same proportion. The cost per horsepower of the generating units would, however, increase somewhat because the units would need to be designed for greater strength to withstand the higher maximum head. The cost of the canal per horsepower would increase slightly, but both of these increases it is believed would be

much more than outweighed by the fact that the dam and controlling works would be unchanged in total cost and therefore reduced in total cost per unit of station output, as they would need to be built to the assumed height for flood control regardless of head utilized. Operation throughout this range has therefore been adopted, based upon the above general reason and for want of time or funds for comparative detailed estimates.

[To be continued.]

The resistivity of soils vary between 1000 and 5000 ohms per centimeter cube. Increasing the pressure tends to slightly increase the conductance, as does likewise increase in moisture and fall in temperature.

The Ferris Bill was passed by the House of Representatives on January 8th, in spite of the opposition of Western Republicans who insisted that its leasing provisions would delay waterpower development. A hard fight is anticipated in the Senate.

SOUTHERN CALIFORNIA EDISON CONDEMNATION HEARING.

The testimony of S. M. Kennedy, general agent for the Southern California Edison Company, before the Railroad Commission of California in its hearing on the condemnation of the company's distribution system in Los Angeles, was concluded December 28th. Mr. Kennedy's evidence was a graphic recital of the building up of the commercial business of Southern California Edison Company, and a projection of its commercial possibilities in the event of severance of Los Angeles business up to the year 1923.

In order to demonstrate that the business of the Southern California Edison Company, outside of Los Angeles, has been developed to a very high degree, Mr. Kennedy presented a statement showing the estimated income per capita in each of the company's districts, and also the total average per capita, namely \$8.84, on the company's system, outside of the city of Los Angeles. A statement was also presented showing the income per capita of twenty of the larger companies scattered over the United States, operating under conditions relatively similar to the Southern California Edison Company. Only two of these companies indicated a larger income per capita than Southern California Edison Company's system outside of the city of Los Angeles. These were the Denver Gas & Electric Company with an income per capita of \$8.86 and the Edison Electric Illuminating Company of Detroit with an income per capita of \$9.74. The average income per capita of Southern California Edison Company is unusually high in spite of the fact that the average rates of the company are considerably lower than in any of the cities referred to on the list presented.

To further illustrate the development of his company's business outside of the city of Los Angeles, Mr. Kennedy presented a statement showing the annual load factors for the year 1914 of twenty large companies located in various parts of the United States. The load factor of the entire system of Southern California Edison Company is 57.86 per cent, and without the city of Los Angeles 50.09 per cent. On the list presented by Mr. Kennedy the highest load factor of companies operating under conditions resembling those of Southern California Edison Company was the Pacific Gas & Electric Company of San Francisco, with a load factor of 60.05 per cent and the Rochester Railway & Light Company with a load factor of 52 per cent.

Mr. Kennedy demonstrated how the business had been developed, and the kind of work which had been done and which is constantly being done to turn every opportunity

into an electric use. Car loads and train loads of gas and steam engines have been purchased by the company in the past and replaced by electric motors. Something like 160,000 electrical appliances for household use, using from 4 amperes to 6 amperes, have been sold by the company to its customers during the past eight years; and, in further development of this class of business Mr. Kennedy explained that his company had found it advisable to purchase from its consumers more than 10,000 sad irons and gas irons allowing a small amount on the purchase price of an electric iron in each case. The company had also purchased from its customers many thousands of coffee pots and allowed a small amount for each with the purchase of an electric coffee percolator. These were instances of the methods adopted to put out electric appliances and apparatus where the ordinary methods of sale would not accomplish the purpose. The estimated annual income from these household appliances in daily use is conservatively estimated to be in excess of half a million dollars.

Mr. Kennedy explained in detail the growth of the business in each of the eleven districts outside of Los Angeles during the past eight years, and gave the causes in each case when the growth seemed to be above normal, and when in some years a district showed a decline there was at hand a prompt reason therefor.

After the record of Mr. Kennedy's experience in the past it seemed as if he were qualified to make an estimate of the probable growth of the company in the future. The maximum demand on the company's system for the year ending June 30, 1915, was 55,880 kilowatts, and the maximum demand for the same period, if the Los Angeles business were severed, would be 34,261 kilowatts. It was estimated that the present load factor on the company's business outside of the city of Los Angeles, namely 50.09 per cent, would continue during the coming year, and according to Mr. Kennedy's estimates of kilowatt hour consumption it appeared that by June 30, 1923, the new business, outside of the city of Los Angeles, would have reached a maximum demand of 55,212 kilowatts, or about 668 kilowatts less than it was during the year ending June 30, 1915. However, the volume of business for the year ending June 30, 1915, would not have been regained in 1923, although the peak demand would be regained approximately at that time, the deficiency being accounted for by the difference in load factor. The total estimated increase in kilowatt hour output for the year ending June 30, 1923, was approximately 68,000,000 kilowatt hours more than for the year ending June 30, 1915, in the event of severance of the Los Angeles business from the company's system. Mr. Kennedy's testimony clearly demonstrated that in the event of severance of the company's business in city of Los Angeles from the balance of the system, the conditions of operation of both the severed portion and the remaining portion of the business would be seriously affected. From a present system load factor of approximately 58 per cent, the Los Angeles business would, if severed, immediately drop to 47 per cent and outside of Los Angeles the load factor would be 50 per cent. This retrogression would have a disastrous effect on operation, and expenses would increase all along the line. Mr. Kennedy's estimates for the future growth on the system outside of Los Angeles were based upon the company's ability to operate in the future as it had been doing in the past; namely to be enabled to keep its costs down to the present minimum and thereby to be able to quote such rates as would attract new business as well as hold old business, and, further, be in a position to meet competition from any source. The trend of Mr. Kennedy's assumption was that in the event of severance of that portion of the business now in the city of Los Angeles, the Southern California Edison Company would be allowed full compensation for the injury and damage to the remaining portion of its property through the loss in load factor and diversity factor, as well as the disruption to the organization which would inevitably follow.

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The financial floundering of the farmer have tended to deter investment in agricultural securities in general and irrigation bonds in particular. The average farmer is encumbered with a heavy load of debt, the aggregate of which is not conducive either to encourage investment or to assist in the rapid development of the land. Some form of relief is necessary.

In the past, irrigation projects have suffered greatly from land speculation, undue taxation and disproportionate promoter's profits. The irrigation district has done much to eliminate these evils, but there still remains the fact that the irrigation district bond does not always find a ready sale.

This sluggishness is largely due to the unnecessary diversity of securities. The forms of irrigation bonds are legion, their differences create misunderstandings and the consequent confusion destroys confidence. There is need for uniformity and standardization in irrigation district bonds.

One way in which this greatly to-be-desired uniformity could be accomplished would be by the enactment of the bill which has been introduced in Congress by Senator W. L. Jones. While providing for federal guarantee of interest on irrigation district bonds, it makes possible the requirement that the irrigation district laws of each state be uniform, so that advantage may be taken of the law's provisions.

The proposed law employs the irrigation district as the unit which shall issue forty-year four per cent bonds, to be guaranteed by the Secretary of the Interior after his department has examined and approved the plans. This scheme can be extended to projects completed under the Reclamation Act and would probably supersede it, as it is now practically inoperative for new developments. The laws of the several states could then be so modified that an irrigation district bond would have the same meaning in all parts of the country and thus become attractive to investors.

Some such action is necessary to make possible the development of a large portion of the semi-arid West. A greater agricultural activity is the backbone of this nation's continued prosperity. The farmer, more than any other class, needs aid and encouragement.

Most of the engineers in the West are heartily in accord with these principles. The public utility men, likewise, realize that their prosperity is dependent upon that of the districts they serve. Some banking concerns, however, are inclined to regard any proposal for government aid in the matter of rural credits as an encroachment on their present prerogatives.

A number of excellent suggestions have been made by the bankers whereby every farmer can obtain credit by simplifying the machinery of the investment market without the necessity of direct loans by the government. They point out the fallacy in attempting to fix interest rates by statute and suggest that the problem

might be cared for by a number of district land banks similar to the federal reserve banks. This proposal has the merit of not making the farmer an object of charity. There is a vast moral difference between helping a farmer help himself and giving him something for nothing. The one develops independence, the other breeds dependence.

It is to be hoped that Congress will not adjourn without providing the needed relief. There is nothing that can add more to the material prosperity of this country than the cultivation of the millions of acres of arable lands which need only a restoration of the investor's confidence so that funds may be available to irrigate them and thus make them productive.

News of a most remarkable decision by the Washington Public Service Commission was published in these columns two weeks ago.

Where Ignorance is Not Bliss Commission decisions may be remarkable for either one of two characteristics—either a broadness and clarity of vision, or otherwise. With all due respect to commission decisions in general, candor compels classification of this particular decision in the latter category.

It seems that the Pacific Power & Light Company has been charging rates of from ten to sixteen cents per kilowatt hour for residence lighting in a number of small towns throughout eastern Washington. These rates are higher than those charged by other companies in Washington and California performing a like service. Among the reasons assigned by the commission for the higher rates is the fact that the power company is selling to large consumers "at or below average cost, and in order to show a fair return the company must make up whatever loss there may be by high rates to other consumers of electrical energy."

The commission fails to add that these rates to large consumers are likewise higher than rates to similar large consumers elsewhere. They seem to overlook the influence of both load factor and diversity factor in the making of a rate. The amount of current used by a consumer is of less consequence in determining the cost of service than is the time at which this current is used. Furthermore the low rates to small towns in the Puget Sound region and in California have been made possible by the fact that there are large cities at the terminals of the transmission lines passing through these small places.

The demand factor, likewise is a feature, whose import is apparently not fully appreciated by the commission when it reduces the charge of \$12 a horsepower year of the connected load to \$1 per month per horsepower, payable during those months that the power is being used. This is equivalent to cutting the revenue from this class of business almost in half as irrigation is practiced only six or seven months during the year. Meanwhile expensive equipment is being held idly in readiness.

Yet, like many another commission decision, the bark is worse than the bite. The actual reductions ordered by the commission are no greater than would

undoubtedly have been voluntarily made by the company in order to encourage the use of electricity in a territory which is destined to a rapid increase in industries and population. We hold no brief for the company in this case, but merely suggest the desirability of a better understanding on the part of the commission of the importance of load, diversity and demand factors in arriving at a proper rate.

On every hand is the belief that business is better and though many can give no definite reason for their belief, the feeling is in the air and is perhaps a precursor of rapid improvement. But an optimism which is unfounded or outside the pale of

possible realization may be but hallucination and it is well to analyze closely the belief in business improvement and so prepare for the wave crest of prosperity or to weather continuance of an undesirable depression.

The pessimist will grumble that improvement has been prophesied for the past seven years without fulfillment. Well, that should be a long enough period to justify a change. And whether optimist or pessimist is right, the fact remains that there is room for improvement and the majority, expectant, are ready though perhaps not prepared for it.

Practically all other successes contribute to the success of the electrical industry.

For the past two years crops have been usually good and money which recently sought the long stocking has been again enticed into the open and seems available in greater plenty everywhere for commercial expansion.

Though governmental uncertainty and unwarranted restraint have not been entirely removed from water power and necessary hydroelectric development allowed to proceed untrammelled, the greater appreciation and growing demand for improved appliances is everywhere in evidence while the Aladdin cry of "New lamp for old" is adding greatly to the prospects of that desirable prosperity which all anticipate and which will make further construction and additions to plant inevitable.

The belief in improvement finds added support in the existence of a car shortage and in various freight blockades due, it is affirmed, not so much to the movement of munitions and materials of war as to domestic merchandise. Increased industrial activity is an actuality.

War orders, which have been enjoyed largely by the East, are but an unreliable, and at the best, artificial business stimuli and it is the part of wisdom for the West to realize that its prospective wave of prosperity will not be largely or materially influenced from this source but will arise out of a natural and healthy though unprecedented growth. Electrically, the West will maintain its high record of per capita consumption, or, rather, utilization of current.

The belief that business is better and will be better still is well founded. The penalty of progress is obsolescence but the reward is increased business. Opportunity is importunate in her efforts to arouse. Prosperity is upon you but you must stretch forth your hand.

PERSONALS

H. E. Sanderson, Pacific Coast manager Bryant Electric Company, is at Seattle.

J. A. Foster, electrical dealer of San Mateo, spent the last few days at San Francisco.

R. E. Frickey, engineer Northern California Power Company at Redding, has been at San Francisco.

J. A. Hunt, proprietor of the J. A. Hunt Electric Company, Pleasanton, Cal., was a recent visitor at San Francisco.

George Neth, superintendent of the Exide depots of the Edison Storage Battery Company, is at San Francisco.

E. D. Hollenbeck, electrical contractor and dealer of Gilroy, Cal., was a recent business visitor at San Francisco.

J. W. Knibbs, formerly with the Otis Elevator Company at San Francisco, has been transferred to the company's Portland office.

H. B. Kinney, president and general manager of the Calistoga Light & Power Company, was a recent business visitor at San Francisco.

J. H. Lash, chief engineer for the Technical Bureau Svend of Java, is at San Francisco in the course of a trip of inspection through the United States.

W. A. Kramer, formerly with the Allis-Chalmers Company, and recently in business for himself at Portland, has opened an office in San Francisco.

W. L. Goodwin, vice-president and sales manager of the Pacific States Electric Company, is making a month's business trip to Portland, Seattle and the Northwest.

Chas. E. Bruff of the engineering firm of Bradley, Bruff & Leborthe, has returned to Alaska, after placing some large contracts for electrical apparatus to be installed during the spring.

G. R. Purvis, Pacific Coast manager of the Hurley Machine Company, recently returned to San Francisco in company with Mr. Hurley, having spent the past two months in Southern California.

P. M. Longon, comptroller of the Mount Whitney Power & Electric Company of Visalia, Cal., with **F. G. Hamilton**, superintendent western division of that company, were recent visitors at San Francisco.

H. F. Wolfe, sales manager of the California Electric Supply Company, at San Francisco, who has been confined to his bed for the past week with a serious illness, expects to be out shortly.

E. A. West, efficiency engineer for the Portland Railway, Light & Power Company, is at Denver, Colorado, at the request of **F. W. Hild**, vice-president of the Denver Tramways Company, to advise on an efficiency system for that company.

Max Loewenthal, electric heating expert, who has been doing special work for the California Railroad Commission at Los Angeles, has been made consulting electrical engineer for the Dohrman Commercial Company and their ten retail stores.

J. B. Megson of the Busch-Sulzer Diesel Engine Company of San Francisco, has just left for Texas with the Diesel engine which was installed at the P.-P. I. E., which is to be erected in the plant of the Houston Ice & Brewing Company, Houston, Tex.

Neil C. Hurley, president of the Hurley Machine Company, and **E. N. Hurley**, vice-chairman of the Federal Trade Commission, and family, arrived at Los Angeles recently, where he will leave them for the winter. Mr. Hurley spent a few days this week at San Francisco, and from there he intends to visit Portland and Seattle before returning East.

A. H. Griswold, plant engineer of the Pacific Telephone & Telegraph Company at San Francisco and **L. T. Ferris**,

research engineer for the company, addressed the Portland sections of the American Institute of Electrical Engineers and the National Electric Light Association on the subject of inductive interference between power circuits and telephone lines at the January 11th meeting.

J. G. De Remer, at one time chief engineer of the United Light & Power Company, at San Francisco, has resigned as manager of the general engineering department of the American District Steam Company, to take up private practice in general engineering in New York City. He will make a specialty of the promotion and development of district heating in combination with electric central stations.

Harmon F. Fischer has resigned as assistant professor of electrical engineering at the University of California to join the Research Company of New York City as electrical engineer. This company is developing the Cottrell precipitation patents. On his way East he is inspecting the several plants already equipped, including those at Riverside, Cal., Tooele and Garfield, Utah, and a number of plants in Colorado.

OBITUARY.

George A. Wilbur, one of the few remaining pioneers of the early-day electrical development in California, died at San Francisco January 7th, after an illness of over a year. Mr. Wilbur came to California in 1884 to supervise the installation of a street lighting plant built by the Fort Wayne Electric Company for the Stockton Gas Company. After arranging for city lighting plants at San Diego and Alameda he went East in 1885 and was made district manager for the Fort Wayne company at Philadelphia. He was highly successful in this work, selling and establishing many central stations in that district. He remained with the company until it was taken over by the General Electric interests. In 1904 Mr. Wilbur returned to California as the representative of a number of electrical manufacturers. After the fire of 1906 he was with the Standard Electric Works for a time and then established himself as a manufacturers' agent handling Duncan meters, Triumph generators and other lines. He was a man of the highest personal character, a Mason and an active church worker. His life was spent in the service of others and his passing leaves a gap in the ranks of the old timers. He is survived by a wife and daughter, brother and sister.

Loren E. Hunt, chief assistant city engineer of San Francisco, died January 8th at San Francisco, following a brief illness. Mr. Hunt was born in Minnesota in 1870. Three years later his parents moved to Santa Barbara, where he lived as a boy. He was a graduate of the University of California, and during his college days was a famous athlete. Following his graduation he became a lecturer on civil engineering at the university. In 1902 and 1903 he was assistant city engineer, going back to Berkeley then as a lecturer until 1909, when he again became assistant city engineer. In 1911 he was made chief assistant. He leaves a widow and a son.

MEETING NOTICES.

Alameda County Electrical Development League.

In lieu of the regular monthly meeting for December, the Great Western Power Company will banquet the membership on January 17th, with a dinner cooked entirely on an electric range. Covers are being set for those directly connected with the power company in their campaign for "Cooking With Electricity" and will represent many of Oakland's leading "lights" in the electrical industry. W. W. Briggs and others equally prominent will deliver short talks.

San Francisco Electrical Development and Jovian League.

The League's first luncheon of the year was held January 5th at the Palace Hotel with an attendance of 106 members. President E. M. Cutting acted as chairman of the day, telling of the plans for an active administration and announcing the personnel of the several committees. A number of excel-

lent vocal numbers were rendered by the Columbia Park Boys' Club. In accepting the league's contribution of \$26.50 to their work, Major Sidney S. Peixotto, their leader, told of the good that is being accomplished in thus educating boys. Dr. J. Wilson Shields then gave a most interesting talk regarding human types, interspersing his serious characterization with humorous stories. He deplored the lack of idealism in the people and made a strong plea for the development of well-rounded men.

Jovian Electric League of Southern California.

The regular weekly meeting of the league—the first of the new year—was held as usual at Christopher's on January 5th, President Holland in the chair. Mr. Holland called on O. D. Harris of the Pacific Electric Railway Company, chairman of the day, to take charge of the meeting. The chairman introduced a number of New Year resolutions for the benefit of various members, which were heartily applauded. He then introduced Clarence E. Adams, the speaker of the day, who gave a highly interesting and instructive talk on "The Kaiser and His Empire—a Lesson in Efficiency." Mr. Adams, who has traveled extensively throughout Europe for a number of years, stated that in his belief the day of petty competition has practically passed, and that success is principally achieved through earnest and thorough co-operation. He sketched in a few words the commercial rise of the German nation, and pointed out the fact of its being due principally to an intelligent application of efficient methods in manufacture and marketing. He felt that all countries could take a lesson from the German Empire in this respect, and that the careful analysis and study made in that country of manufacturing methods will have its effect on business throughout all countries. He pointed out that the Emperor himself has not confined his attentions to building the military and naval program of the country, but that he personally had been largely responsible for the development of manufacturing industries and foreign commerce.

Entertainment was furnished by F. B. Howe, blackfaced minstrel, who gave a number of excellent dialect stories and songs, which were heartily applauded. Chairman of the day for the meeting of January 12th is H. W. Harrison, Southern California representative of the General Vehicle Company.

Portland Sections A. I. E. E. and N. E. L. A.

The regular bi-weekly luncheon was held in the Commercial Club, January 6th. Thomas McCuster and Frank Branch Riley of the Portland Chamber of Commerce, made talks for letter-writing week, January 17-28, which is a campaign to spread the fame of Oregon broadcast. Mr. B. F. Boynton, claim agent P. R., L. & P. Co., made a talk on "Safety First" movement with special reference to the work done by the Portland Railway, Light & Power Company. He said in part: Harmony must exist through every company before any consistent "Safety First" work can be accomplished. The first attempt to establish harmony in Portland Railway, Light & Power Company was accomplished by a picnic for all the employees. This was such a success that it became an annual affair. Then the company commenced the "Safety First" education by teaching all of the employees "courtesy." After this followed instruction in "prevention" work. When this work was first undertaken the accidents averaged 38 per day, and only one-half the passengers being hauled there are at the present time. To accomplish better results a "Safety Commission" was organized within the company composed of employees. The accidents decreased until there were only eight accidents per day. This continued until the automobile and "jitney" made its appearance, when the accidents double again. Eight years ago "safety first" education was started in the public schools. The results being that Portland has the best record of any city in the United States as regards accidents to school children. The Portland Railway, Light & Power Company has

the best record in the United States for surface transportation, as they have carried 750,000,000 passengers in seven years without killing one.

H. P. Coffin, chairman Safety First Commission, Portland, Oregon, read a comprehensive address on the subject and pointed out in detail the work being done in Portland.

Jay Stephens, fire marshal, also made a short talk upon his work of catching and prosecuting arson cases and catching parties turning in "false fire" alarms. He also told of how the school children were being educated along "safety first" lines. Attendance 60.

NEWS OF OREGON PUBLIC SERVICE COMMISSION.

The Western Telephone Company has been given permission by the commission to change its rates for telephone service in its exchange at Woodburn, Oregon.

The commission has denied the application of the cities of Marshfield and North Bend for a modification of the rates of the Coos Bay Water Company and has ordered that a 250,000 gallon reservoir be constructed, but has eliminated the previous requirement for a ten-inch main.

NEWS OF ARIZONA CORPORATION COMMISSION.

All electrical corporations operating in Arizona have been ordered to file with the commission on or before March 1, 1916, their annual statement for 1915. All gas, electric and water companies, likewise, are ordered to file schedules of rates in effect January 1, 1916.

The complaint against the Pacific Gas & Electric Company for not refunding the cost of wiring a real estate tract has been ordered dismissed.

The Pacific Gas & Electric Company has been authorized by the commission to sell 50 six per cent \$1000 bonds and 25 six per cent \$1000 convertible debentures at a price of not less than 90 and 85 per cent respectively of their par value.

CIVIL SERVICE EXAMINATIONS.

The U. S. Civil Service Commission announces that examinations will be held March 15, 1916, throughout the United States for the following positions:

Aid, Bureau of Standards (men only); Aid, Coast and Geodetic Service (men only); Assistant, Philippine Service (men only); Assistant Examiner, Patent Office; Assistant Inspector of Boilers, Steamboat-Inspection Service; Assistant Inspector of Hulls, Steamboat-Inspection Service; Computer, Coast and Geodetic Survey (men only); Draftsman; Copyist, topographic, Departmental Service; Engineer Department at large; Marine engine and boiler, Navy Department (men only); Ship, Navy Department (men only); Topographic, Departmental Service; Engineer, second class (or assistant), steam, Departmental Service; Forest Assistant, Forest Service (men only); Industrial Teacher, Philippine Service (men only); Junior Engineer, mechanical or electrical, Engineer Department at large; Laboratory Apprentice, Bureau of Standards (men only); Land Law Clerk, Departmental Service; Local Inspector of Boilers, Steamboat-Inspection Service; Local Inspector of Hulls, Steamboat-Inspection Service.

PUBLICATIONS RECEIVED.

Technologic Paper No. 56, U. S. Bureau of Standards, "Protection of Life and Property Against Lighting," by O. S. Peters. Technologic Paper No. 26, "Earth Resistance and its Relation to Electrolysis of Underground Structures, by Burton McCollum and K. H. Logan. Scientific Paper No. 259, "A New Relation Derived from Planck's Law," by Paul D. Foote.

The 1915 edition of the National Electrical Code, Regulations of the National Board of Fire Underwriters for Electric wiring and Apparatus, as recommended by the National Fire Protection Association.



NEWS NOTES



FINANCIAL.

HONOLULU, T. H.—If the plant of the Honolulu Rapid Transit & Land Company, as it stands today, was to be reproduced either in Hawaii or elsewhere, it would cost \$2,448,972, according to the estimation of W. A. Cattell, civil engineer and expert on valuations, according to testimony which he has given in Circuit Judge Stuart's court in connection with the trial of the territory's injunction suit against the Rapid Transit. According to Mr. Cattell's testimony, the depreciation of all the units of the company's system, to date, amounts to \$447,034. This includes all the items in the plant, regardless of whether they were installed 10 days or 10 years ago. On April 30, 1915, Mr. Cattell had testified the Rapid Transit plant was worth \$2,041,938.

RIVERSIDE, CAL.—W. F. Holt of Redlands, Cal., has sold his electric power plants, transmission lines and electric railway in the Imperial and Coachella Valleys to the Southern Sierras Power Company of Riverside for about \$1,500,000. The transaction included the transfer of four electric power plants located at Holtville and El Centro, in the Imperial Valley; the main power transmission line running from Banning to El Centro, including distributing systems in the Imperial and Coachella Valleys; the Holtville interurban railway from El Cerrito to Holtville; the Coachella Valley Ice and Electric plant at El Centro, and real estate valued at \$200,000. The gas plants at El Centro, Imperial and Brawley, in the Imperial Valley, and real estate valued at \$500,000 were retained by Holt.

INCORPORATIONS.

TACOMA, WASH.—The Intermountain Traction & Power Company has been incorporated for \$500,000 by I. M. Iles, F. B. Chandler, Alfred B. Iles.

SEATTLE, WASH.—The Electric Heating & Manufacturing Company has been incorporated for \$75,000 by P. F. Appel, R. H. Walker and James G. Eddy.

SAN FRANCISCO, CAL.—The Great Western Electrical Chemical Company has been incorporated with a capital stock of \$2,500,000, by C. E. Hall, E. Mackennae, W. Forrest, H. A. Cooke, L. A. Reynolds, J. A. Koontz, G. E. Oaks, J. B. Hassett and S. H. Harold.

SANTA ANA, CAL.—The Newport Heights Water Company has been incorporated with a capital of \$120,000. The directors are: S. Townsend and A. T. Covert of Long Beach, D. J. Dodge, George Huntington and H. B. Woodrough of Newport Heights.

ILLUMINATION.

FT. SUMNER, NEW MEX.—F. C. Baker is planning to install water works and an electric plant here.

HUNTINGTON, BEACH, CAL.—At the recent election bonds in the sum of \$20,000 were voted for the purpose of installing a gas distributing system.

LOS ANGELES, CAL.—The board of supervisors has awarded a contract to the Southern California Edison Company for lighting the Hawthorne lighting district.

WASHTUCNA, WASH.—The power plant in Washtucna, owned by the Washtucna Light & Power Company, was destroyed by fire recently. The loss is estimated at \$1000.

SAN BERNARDINO, CAL.—Property owners have signed an agreement to pay for the installation of boulevard lights on Fourth street, between D and E, and on E street between Third and Fifth.

ABERDEEN, WASH.—The request of George H. Tilden for a 50-year franchise to install an electric lighting, heating

and power system here probably will be referred to the people at the next general election.

REDDING, CAL.—The city trustees rejected all bids for the erection of the first unit of a municipal lighting system, on the ground that the bids submitted were too high. The board will now go ahead with the work on its own account.

HAMILTON, MONT.—As soon as a flow of 75,000,000 to 100,000,000 cu. ft. of gas can be secured from the Havre gas field the company expects to pipe the product to Helena and Butte, according to W. H. Wheeler and C. A. Rose.

COUPEVILLE, WASH.—The electric lighting plant of Coupeville has been purchased by the Whidby Electric Company at Langley. W. C. Cheney, former owner, stated that the new company will begin immediate improvements.

LOS ANGELES, CAL.—The board of supervisors will receive bids up to January 17th for installing and maintaining an addition to the street lighting system in the Annandale lighting district, in accordance with specifications on file with the board.

WICKENBURG, ARIZ.—P. M. Jewett, who purchased the local electric plant, is preparing to operate on a large scale at Lynch Creek. He is moving part of the equipment from the local plant to that place and expects to install a lighting system there.

SAN FRANCISCO, CAL.—The illumination of Market street was discussed when more than 100 representative San Francisco business men and city officials met at luncheon under the auspices of the Downtown Association with Walter D'Arcy Ryan, the Exposition illumination expert. Ryan's scheme to make San Francisco the best lighted city in the world was approved by Supervisors James E. Power, Edward L. Nolan and Joseph Mulvihill of the lighting committee of the new board of supervisors.

TRANSMISSION. . .

LIVERMORE, CAL.—Local agent E. W. D'Ombra of the Pacific Gas & Electric Company, announces that power lines will be built several miles out East avenue.

SAN BERNARDINO, CAL.—Improvements are being planned by the Pacific Light & Power Company. A switching tower will be erected at Second and Arrowhead to cost \$2000 and the quarter block at Second and Arrowhead avenue will be cleared for the erection of a substation which will cost \$50,000.

LOS ANGELES, CAL.—President Betkouski of the city council states that the water board will take immediate action looking to the construction of the municipal system for the distribution of aqueduct electrical power in the Hollywood, Highland Park and East Los Angeles sections. He declares that unless the power corporations submit a fair price, the water board will call upon Chief Engineer Scattergood to present his plans for the municipal distributing system and make call for bids to furnish material and equipment according to his plans.

TELEPHONE AND TELEGRAPH.

SANTA ANA, CAL.—The Pacific Telephone & Telegraph Company is ready to begin the construction of a telephone building at Fifth and Bush streets. The company has completed the installation of new cables at a cost of \$30,000.

WALLA WALLA, WASH.—Russel Creek farmers have voted to incorporate a company to be known as the Russell Creek Telephone Association. The company will be owned by the farmers of that section and will control the present Russell Creek telephone line, making improvements and extensions as needed.

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POWER AND GAS

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SAN FRANCISCO, JANUARY 22, 1916

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A NOVEL AND EFFECTIVE LIGHTING INSTALLATION

DIESEL ENGINE PRACTICE

BY J. E. MEGSON AND H. S. JONES.

AVAILABLE POWER FOR COLUMBIA RIVER PROJECT

BY L. F. HARZA.

STEAM CONDENSERS AND CONDENSER TUBES

BY A. F. C. WOOD.

THE LEWISTON-WAHA POWER SYPHON

BY OTTO B. GOLDMAN.

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Dearborn Chemical Co.

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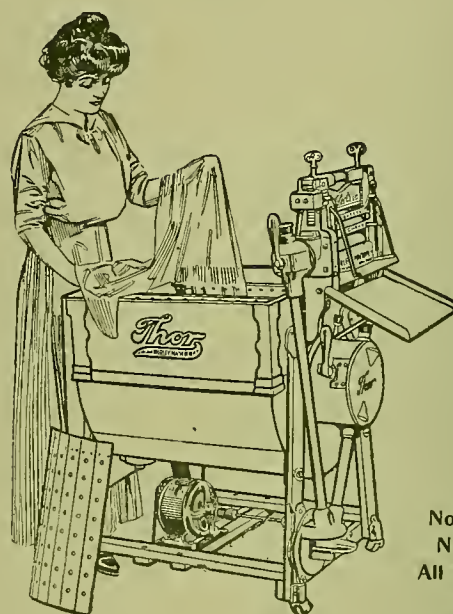
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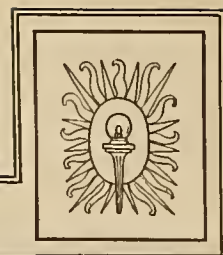
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A NOVEL AND EFFECTIVE LIGHTING INSTALLATION

One of the handsomest and most unique candy and catering establishments in Los Angeles is the new store of L. J. Christopher, situated on Broadway, between Seventh and Eighth streets. Mr. Christopher placed no restrictions on the architect, decorator and illuminating engineer and co-operatively they have created a work of art, without the sacrifice of utility.

The lighting, with which this article is to deal, required, in view of the architectural and decorative conditions, considerable study and special treatment.

brocade, very susceptible to surface distortion in a strong light. The desired method of illumination required pedestals, surmounted by shallow bowls, 21 by 4½ in., supported 7 ft. 6 in. from the floor and 4 ft. 2 in. from the side walls. There are eight units on each side, or sixteen in all. Each bowl is equipped with one 250 watt type C stereopticon lamp, which direct rays of the lamp from the side walls, reflecting made of opal cathedral glass. This reflector cuts the direct rays of the lamp from the side walls, reflecting the light upward and toward the center of the room.



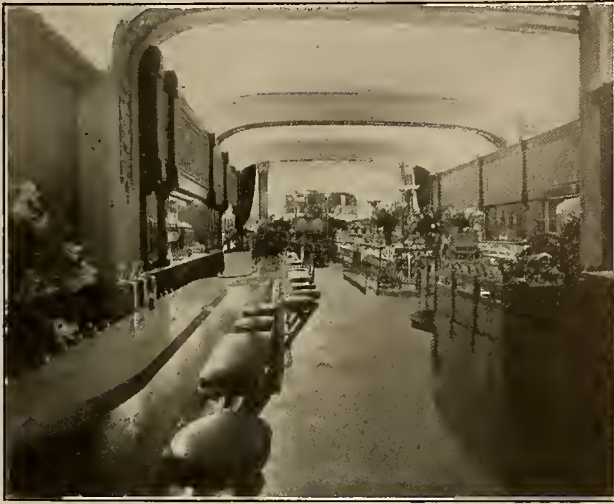
Unique Lighting of Christopher's Banquet Hall.

The forward half of the store proper receives softly diffused general illumination by means of mirror lined trough reflectors, located in coves, constituting a cove system of illumination, devoid of glare. The show and counter cases are lighted by specially designed reflectors, equipped with 15 watt, T8 candelabra lamps. The heat factor is so inconsiderable that the candies and chocolates are not affected. The combination of cove and case lighting makes an ideal condition for the attractive display of case goods, the soft general illumination being ample, yet allowing the case contents to be emphasized with low candle power lamps.

The rear half of the store presented a difficult condition. The sidewalls are hung with dark blue silk

They serve also as screens, allowing only enough light to penetrate to produce a soft, even glow in and over the large bowls. The effect obtained is that of a cove system so even is the illumination and so devoid of glare. Photometric tests show an average intensity of 2 f.c. at a wattage cost of about 1.7 w.p.s.f. The large banquet room on the second floor is equipped with a most unique system of illumination. It is claimed that this is the only room illuminated by means of projectors. There are 16 of these, 8 on each side of the room, located as shown in the illustration. Each projector is of spun brass, heavily plated, 18 in. in diameter and equipped with a 250 watt, type C stereopticon lamp. As the cut shows, the ceiling is divided into four panels, in the center of each being

a compo-plaque of conventional sun-burst design, 5 ft. by 7 ft., overlaid with aluminum foil, stained in different colors. There is a curve to each plaque, so designed that when a pencil of light from the projector strikes its surface it is deflected and diffused at the proper angle. The inside of each reflector holder is



Cove Lighting of Front Part of Store.

painted in stripes of vivid red, green and blue and these colors in turn are reflected to the upper edge of each projector which has the appearance of a huge iridescent bubble about to drop from the container. Due to the characteristics of the parabola, there is absolutely no glare, and the beams of light are invisible, except when the diners are smoking. Contrary to expectations, these beams then add interest to the room, rather than prove objectionable. The entire



Pedestal Lighting of Rear of Store.

scheme is unusual and daring and the general effect extremely beautiful and unique.

The average intensity on the floor, which measures 85 ft. by 30 ft. and is 13 ft. 6 in. from the ceiling, is 1.6 f.c. and the wattage is about 1.2 per sq. ft.

This installation deserves special mention, not alone on account of its beauty, but because it marks a decided step forward in the art of interior illumination. Due credit should be given to L. C. Norton, a local illuminating engineer, who is making a splendid record for himself in Los Angeles, and Arthur Hemen, the architect of the establishment.

THE LEWISTON-WAHA POWER SYPHON.

BY OTTO B. GOLDMAN.

Lewiston, Idaho, is situated at the junction of the Snake and Clearwater Rivers. Its elevation above sea-level is 650 ft. The hills southeast from Lewiston rise abruptly to about 1200 ft. elevation, then gradually rise until a distance of twenty miles is reached and then another abrupt rise is made into the mountain range. These hills are barren and dry, but the soil is fertile and deep. As the hills are rolling they have an excellent cold air drainage.

The bringing of water to so large a tract of land has been the problem of over half a century.

Twenty-five miles southeast of Lewiston is a chain of three lakes. The lakes are situated one above the other, the highest one, Lake Waha, lying at an elevation of about 3100 ft. and has an area of about one square mile, with a maximum depth of 90 ft. The two lower ones are, however, comparatively small.

Lake Waha was formed by the fill between two projecting spurs of the mountains. This fill is not impervious to water, and the leakage through it forms the lower lakes.

The lower lake was also fed by a spring of about three second feet. This spring is quite a distance above the lake, so that it was possible to flume this water above the lower lake bank into the canyon beyond.

This was done a number of years ago by the Lewiston Sweetwater Irrigating Company, the water being carried some 15 miles to a large reservoir, and thence distributed. The quality of the water being excellent it was also used for domestic purposes.

The water from the reservoir is entirely distributed by pipes. The entire tract of the Lewiston Sweetwater Irrigating Company consists of about 8000 acres, of which 6000 acres are now in orchards. On account of this large development a much larger supply of water was imperative. This naturally focused attention on how to get the water out of Lake Waha.

This was an old problem; the first attempt to take the water out of the lake having been made as far back as 1863. Since that time an immense amount of money has been lost in attempting to utilize this water. It must be noted that the fill or lower bank of Lake Waha is 115 ft. above the mean water level, with a base of nearly a mile through, so that tunneling would be a matter of immense cost.

The idea was finally conceived by H. L. Powers, manager of the irrigating company, that the water could be pumped over the fill, then dropped in a penstock sufficiently to develop enough power to operate the pump, thus creating what may be called a power siphon. The idea is not new, having been suggested on other propositions. But the writer knows of no installation of this type actually made.

The irrigating company acquired the water rights of Lake Waha and engaged the writer to design the system. The following data was available: The capacity desired to be pumped was 10 second feet, with a static head of 115 ft. normal and 125 ft. maximum, the total drop of 600 ft. being available. To meet these conditions, a Pelton water wheel was installed direct connected to a 250 k.v.a. General Electric

three-phase, 60-cycle, 2200-volt generator operating at 600 r.p.m., with a seven kw. belted exciter.

The switchboard, besides having the necessary rheostats for voltage control, voltmeter and ammeter, was also equipped with contact making ammeter for underload alarm.

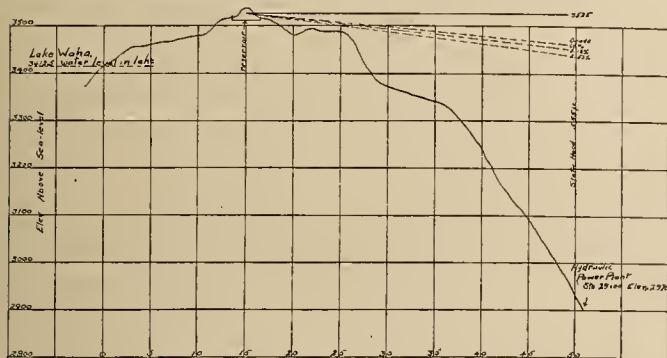


Fig. 1. Profile of Pipe Line.

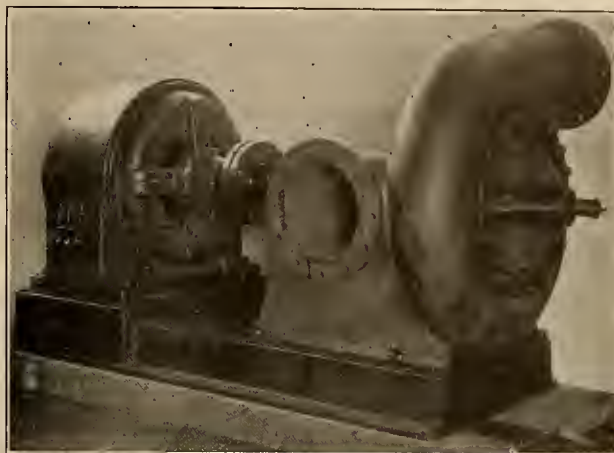
A transmission line was then run to the pump house at the lake, consisting of three No. 3 B. & S. copper wires. These run through an automatic control board to a 250 h.p., 1200 r.p.m. General Electric slip ring induction motor direct connected to a 12 in. single stage Goldman pump. Both the suction and discharge pipe of this pump was 20 in. in diameter. The total length of this riser pipe is about 1800 ft. This empties into a small reservoir of about 3000 cu. ft. capacity. This connects with the penstock, which was installed 16 in. outside diameter. The profile of the entire pipe line is shown in Fig. 1. In order to start the system, it was necessary to fill the entire pipe line and reservoir, and for this purpose there was installed a 35 h.p. Atlas gas engine belted to a 4 in. Class H, single stage Goldman pump. For priming, both this auxiliary pump and the main pump, there was provided a 5x5 double acting plunger pump instead of a vacuum pump as is usually done, to avoid water hammer.

The operation of the system consisted in utilizing the power developed by the water in the reservoir to start the water wheel and generator. The closing of the main switch at the power house caused the automatic control to start the main pump as rapidly as possible with not over 150 per cent of normal full load current. This was necessary to avoid serious overload, which would slow down the entire system, lowering the power factor and efficiencies, to the point where starting would be questionable if not impossible, especially on account of the limited storage capacity. The efficiencies of the various elements in this system are as follows. Water wheel, 78 per cent; generator, 90 per cent; line 92 per cent; motor 90 per cent, and pump, 73 per cent. From the power available at the generator must be deducted the power necessary to drive the exciter. To this may be added riser pipe efficiency of 95 per cent observed, and penstock efficiency of 90 per cent. The combined efficiency water wheel to and including pump is slightly over 40 per cent, and including pipe losses reduces it to about 34½ per cent.

While this appears to be a low efficiency for a plant of this character, it still presents quite a different aspect when considered on the basis of first cost, and proves itself to be a financial success. Because the tunnel, as pointed out previously, which would have

had to be constructed through the fill at Lake Waha would have cost between 30 and 40 times as much.

There are, no doubt, many other propositions, which are feasible with an installation of this type. Care should be taken to see that there is ample drop to allow for the low overall efficiency.



Motor Driven Pump.

In this instance also, the cost of constructing a reservoir was so large that as small a reservoir as was considered safe was used. Under actual test 1000 cu. ft. of water and 1½ minutes of time was all that was necessary to get into full operation. The object in making the riser pipe 20 in. in diameter with only 16 in. outside diameter drop pipe, is evident, from consideration of the overall efficiency. For every additional horsepower lost in pipe friction in raising the water, nearly three water horsepower on the power or drop side must be provided. Consequently the ratio of friction loss in the riser to that in the drop pipe should be approximately in the same ratio, i.e. three to one. In this instance where the power developed was more than ample, the surplus water was allowed to go through a by-pass at the power house.

In consultation the writer had the invaluable suggestions and criticisms of Mr. Hopson, engineer of the U. S. Reclamation Service, Mr. Grelle, M. E. of the Independent Foundry Company, Portland, Oregon, and Mr. Foster of the Lewiston-Clarkston Improvement Company.

Several interesting problems had to be solved. For example, there was considerable temptation to install a squirrel cage instead of a slip ring motor on the pump, and in starting, instead of bringing the generator up to speed first, and then starting the pump, the idea was to bring both generator and pump up to speed together. This was rejected because of the known low power factor, low efficiency and otherwise general lack of definite knowledge as to generator and motor characteristics under these conditions, so that it was questionable whether the system would start promptly, if at all. That our rejection was apparently correct was shown to us in a rather amusing trouble experienced.

When the first attempt to operate the system was made, it operated well the first few minutes, then showed a large increase in amperage with a large reduction in water pumped, so that in a few minutes more the system died down ingloriously. After start-

ing the system, the load on the pump motor was held at about 57 amperes, or full load, by holding constant speed and opening the discharge gate on the pump until this load was obtained.

Observations then showed that with the by-pass closed at the power house so that all the water pumped had to pass through the water wheel or else accumulate in the reservoir. The reservoir was raised rapidly as there was a considerable surplus pumped over that used for power.

The system would then continue to operate for a maximum of three minutes, then there occurred a rapid increase in current up to 100 amperes, and accompanied by a reduction in voltage. Also a reduction of speed generally took place. The discharge gate on the

great deal less than 57. The water rose readily in the reservoir. Suddenly the current rose to 86 and the water began to drop in the reservoir, the voltage became very erratic. Upon an inspection of the exciter we found that this was due to the exciter belt slipping. The belt was treated with dressing and changed, causing the current not to increase as it had done previously.

The trouble with this plant extended over a period of about six weeks, and cost nearly \$3000, with an attendant loss of twice that amount, all because a \$10 belt slipped.

The system is now operating perfectly, and with the successful carrying through of this type of construction, many more similar plants of this type could be used, where conditions for them are proper.

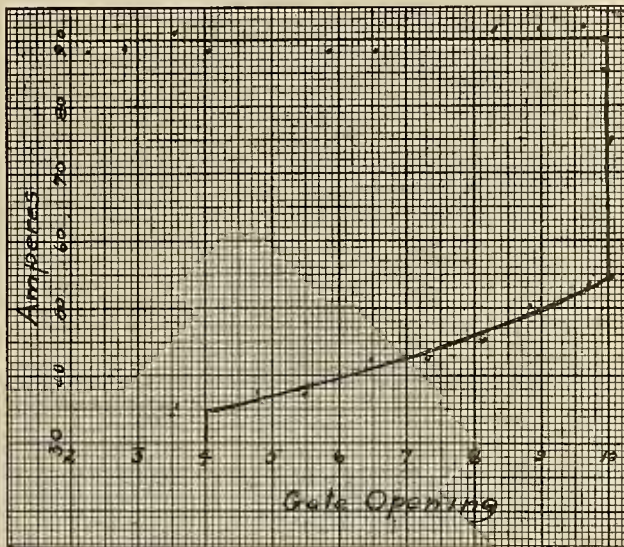


Fig. 2. Typical Test Curve of Mysterious Trouble Due to Belt Slippage.

pump was closed rapidly, but no appreciable reduction in current was observed. Sometimes, when the gate was being closed there would be a reduction in current with an increase in speed.

A typical test curve of this action is shown in Fig. 2. In as much as the water in the reservoir was limited, operation under these circumstances was limited to a maximum duration of 8 minutes. In this short time there was no opportunity for either the electrical or mechanical parts of the system to show excessive heating, so trouble could have been located. After numerous attempts to operate successfully, with the same results, electrical experts were engaged to find the trouble. After a month of investigation they reported the system as far as the electrical equipment was concerned, to be in perfect condition. Their report stated that the trouble must be due to excessive friction in the pump. The voltage drop being due to saturation of the generator due to overload and erratic readings obtained, were due to the short duration of the test periods. Therefore, to prove that trouble did not originate in the pump, the writer was forced to test the system again. Apparently some three hundred horsepower was mysteriously disappearing. The last test was carried on, with the assistance of Mr. C. E. Grelle. We worked on the supposition that the proper speeds had never been obtained. The test was started with reduced speed, so that the current was a

ELECTRICAL SUPPLIES INDUSTRY OF JAPAN

The electrical supplies industry in Japan has grown to a remarkable extent in the 25 years of its existence, and the country is no longer dependent upon foreign countries to supply its needs. Efficient moderate size motors and generators up to 100 h.p. are manufactured at moderate prices. The small sizes of motors up to 10 h.p. are made in large quantities, and comparatively cheap, and the export prices would compare favorably with those of European factories. Transformers are turned out at low prices and of good efficiency, but the iron sheets are in nearly all instances imported.

With the exception of submarine telegraph cable the former large import of insulated conductors has entirely ceased. All classes of electric lighting and power cables, rubber and paper insulated for high or low tension, are made to any specification; flexible silk cords, all types of telephone cable, military and naval cables, are well made in large quantities in well laid-out factories and under expert and scientific supervision. Porcelain insulators and porcelain ware and glassware for all purposes are largely exported. Brass work, switches, lamp holders, and cutouts, although perhaps not quite as good as the best European fashion, are at low prices and good.

Metallic filament lamps are made in large quantities, but practically all the producing factories are controlled by a monopoly which controls the export trade.

Switchboard instruments and meters are still imported where high-class work is required, but for ordinary use the Japanese-made article meets the requirements at half the price of the imported goods. The same may be said about laboratory and testing instruments and telegraph instruments, the native-made articles improving all the time and the imported goods being gradually superseded.

In telephones Japan is not only self-supporting, but is doing a considerable export trade to its near neighbors.

All the various electrical accessories are now being manufactured by small Japanese factories. Electric fans, torches, bells, batteries, devices of every kind as used in Europe and America are obtainable at prices often lower than they can be produced in western countries.—[Summary of an article appearing in "Commercial Japan," Nov., 1915, transmitted by Consul General George H. Scidmore, Yokohama.]

REPORT ON THE COLUMBIA RIVER POWER PROJECT.

BY L. F. HARZA.

Appendix E—Available Power.
(Concluded.)

Secondary power. In addition to the 480,000 horsepower of what is variously known as “base,” “primary” or “perennial” power, available continuously throughout the year, there would also be a large range of heads between maximum and minimum when there would be a surplus of water, head and generating machinery. The surplus water could be used at such times, up to the capacity limit of the machinery, without any additional cost whatever except depreciation of machinery, oil, etc. The power thus furnished is known variously as “surplus,” “secondary” or “seasonal” power.

In Fig. 23 three turbine curves are shown, one applying to the total output capacity of the high head units, one to the total capacity of the low head units, and the third to the combined capacity. A line is also shown representing the normal generator rating of 805,000 kw. or 1,080,000 horsepower. The station generating capacity at any given flow is now represented by the minimum of the three curves representing: (1) the power of the river, (2) the generator rating, and (3) the total power of the turbines. This line it shaded for prominence. The line of 480,000 horsepower or the primary capacity is also shaded. The secondary power is represented by the difference in height between these two curves.

The amount of this surplus power which would be of commercial value depends largely upon the number of days per annum during which it could be delivered with reasonable certainty. Fig. 26 shows an average annual duration curve of the river discharge for the entire thirty-six years and another one applying to the last twenty years. There are also shown two curves of corresponding power capacity taken from the upper shaded line in Fig. 23.

The average number of days and months per year during which certain specified amounts of power could have been delivered, as taken from this curve, are shown in the following table:

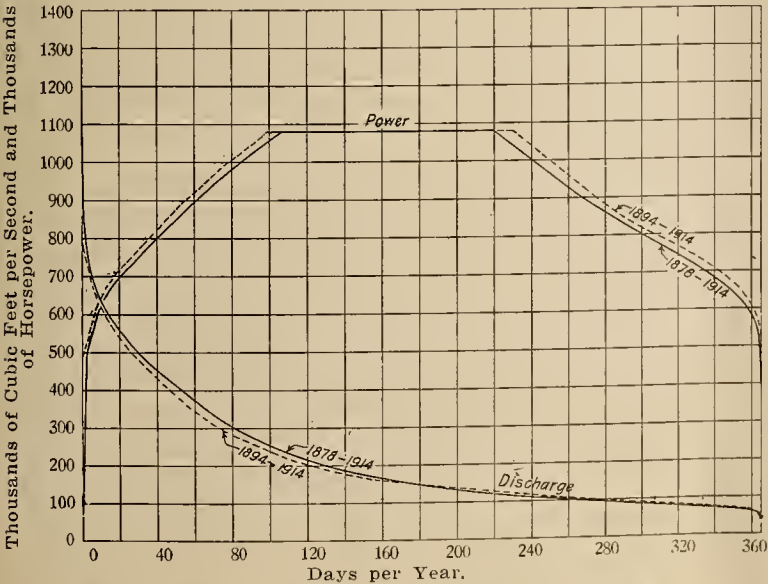


Fig. 26. Mean Annual Duration Curves of Discharge and Corresponding Power.

Delivery in h.p.	Amount of Surplus Above Primary Capacity.	Duration Based Upon 20 Years' Record.		Duration Based Upon 36 Years' Record.	
		Days.	Months.	Days.	Months.
1,080,000	600,000	132	4.34	115	3.78
900,000	420,000	221	7.26	206	6.77
800,000	320,000	270	8.87	262	8.62
700,000	220,000	324	10.66	311	10.33
600,000	120,000	353	11.61	342	11.24

The salability of surplus power depends also largely upon the regularity with which it can be depended upon. Thus, an average duration of eight months per year with a range of from seven to nine months would be more desirable than with a range of from five to eleven months. It also depends upon whether the surplus power results from any freshets of short duration with intermediate deficiencies or in one continuous period.

In these respects the conditions offered by this power site are very favorable. The power would be available in two seasons, each usually continuous for several months. One starts in with the rising stage following the cold season of January or February and continuing until the June flood, the other lasting from the subsidence of this flood to the approach of the cold season again.

Fig. 27 shows by the light line a hydrograph of the year 1887-1888, and by the heavy line the corresponding power curve. These curves are typical as to general shape, but represent a year of both unusually high water and unusually low water. The flood season here shown (1887) was shown in the duration curve Fig. 25, as one of the four extreme floods, and the low season (1888) in Fig. 24 as one of the low periods. The low water fell to 49,400 sec. ft. for one day. The two seasons without surplus power, one for the low water and one for the high water, are plainly evident.

In Fig. 28 are diagrams showing the number of months and days per annum during existing records when power to the amount of 600,000, 700,000 and 800,000 horsepower could have been generated. From these curves it is concluded that the variations of individual years from the mean duration shown in Fig. 26 and in the above table are too large to warrant the adoption of the mean duration. For this reason the following durations have been chosen from this diagram as sufficiently dependable to indicate a commercial value for the power:

Total Delivery in h.p.	Amount of Surplus Above Primary Power.	Months Available Per Annum.
800,000	320,000	8
700,000	220,000	10
600,000	120,000	11

Relation of secondary power to turbine erosion. The use of this secondary power is dependent upon the feasibility of operating the low head units throughout nearly the entire range of heads. The Holyoke test of the low head runner under consideration, after deducting 3 per cent throughout, indicates the following efficiencies:

45 feet head	.....81 per cent
63 feet head	.....86 per cent
100 feet head	.....80 per cent



Fig. 27. Typical Hydrograph and Corresponding Power Capacity of Proposed Station.

These results are believed to be sufficiently high to furnish some assurance against severe erosion, and it may be expected that still better results will have been accomplished before turbines for this installation are to be purchased. Runners of this type have, however, never been used for heads above 75 ft., and their operation without excessive erosion is not certain. The estimated cost will be based upon the use of cast steel runners as additional insurance against depreciation from this source, and the annual depreciation will include a fund for renewal every three years of one-half of all the runners of the low head units. Only one-half of the low head units would be needed for heads above their proven range to maintain the entire surplus power. With this provision it is believed that the surplus power could be depended upon and that the additional depreciation resulting from its use would be justifiable from the standpoint of the additional income.

Power for irrigation. Fig. 6 is a hydrograph representing the diversion of water from the Yakima River in the years 1912 and 1913 for the Sunnyside project, U. S. Reclamation Service. It is probably typical of projects in this region except during the early part of June in 1912, and all of June, 1913, when the curve is apparently lower than normal, probably due to rainfall. It will be seen that June, one of the months of maximum demand, coincides with the maximum flood month of the river and is therefore a period of little or no surplus power, depending upon the magnitude of the flood peak. This can best be studied by reference to Fig. 4 and Fig. 26. Judging from the last twenty years there would have been available during June in all except five years, the difference between the station capacity at 700,000 second

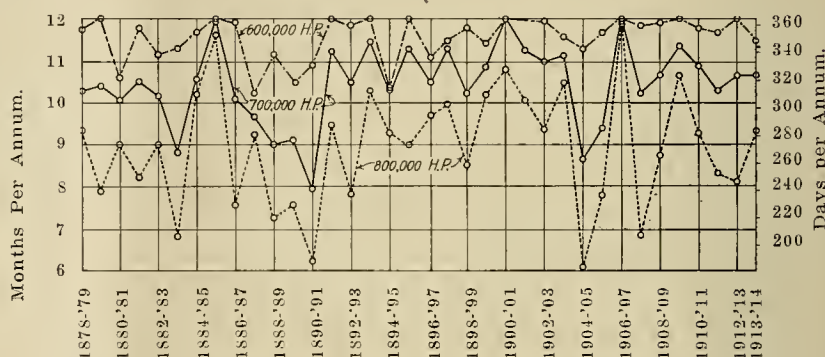


Fig. 28. Annual Duration of Generating Capacities of 600,000, 700,000 and 800,000 Horsepower.

feet and that at 800,000 second feet, for which latter the machinery was chosen. This amounts to about 85,000 h.p. The possibility of the recurrence of another period of high years such as those from 1858 to 1894 would seem to preclude the possibility of dependence upon floods less than 800,000 second feet for a supply of surplus power for irrigation purposes, for which certainty of supply is more important than for manufacturing.

Power for irrigation must for this reason be obtained by the installation of additional machinery or by the use of primary power. This is unfortunate, since surplus power, if available during the irrigation season, could be sold at a much lower price. By the use of additional machinery, in case space for canal and power house could be obtained, a large amount of power could be generated for this purpose. The minimum flow during April for thirty-six years was 87,400 second feet, on April 5, 1880. The usual minimum is much higher. The minimum flow toward the end of the irrigation season has occurred in September on three occasions: 1889, 1903 and 1905, the discharges being 78,000, 130,000 and 77,800 second feet respectively. Otherwise the minimum has occurred in Octo-

ber, usually near the end of the month. The following table shows the lowest flows for the first of, and for the entire irrigation season, with date of occurrence:

Table of Minimum Discharges During the Irrigation Season.

Year.	Minimum Flow of Season.	Date of Occurrence.	Minimum of Entire Season.	Date of Occurrence.
1878	176,000	April 24	82,900	Oct. 31
1879	313,000	" 1	91,000	" 31
1880	87,400	" 5	87,400	April 5
1881	278,000	" 1	99,100	Oct. 25
1882	192,000	" 1	102,000	" 28
1883	167,000	" 26	79,000	" 27
1884	117,000	" 1	112,000	" 7
1885	215,000	" 1	95,400	" 30
1886	128,000	" 2	76,000	" 31
1887	235,000	" 1	99,300	" 31
1888	129,000	" 1	89,200	" 23
1889	110,000	" 1	78,000	Sept. 27
1890	145,000	" 1	83,400	Oct. 24
1891	88,000	" 7	80,100	" 26
1892	128,000	" 8	96,000	" 31
1893	130,000	" 1	108,000	" 29
1894	266,000	" 8	125,000	" 21
1895	143,000	" 1	84,500	" 31
1896	152,000	" 7	78,000	" 31
1897	130,000	" 1	85,600	" 31
1898	111,000	" 1	85,600	" 30
1899	120,000	" 3	120,000	April 3
1900	216,000	" 1	99,000	Oct. 19
1901	137,000	" 6	77,000	" 31
1902	88,300	" 3	76,200	" 31
1903	160,000	" 18	130,000	Sept. 23
1904	164,000	" 1	75,400	Oct. 31
1905	114,000	" 10	77,800	Sept. 25
1906	165,000	" 1	85,600	Oct. 15
1907	156,000	" 2	96,000	" 31
1908	110,000	" 11	83,800	" 27
1909	132,000	" 1	91,000	" 31
1910	249,000	" 8	81,100	" 1
1911	134,000	" 20	75,400	" 31
1912	113,000	" 1	85,600	" 31
1913	155,000	" 1	102,000	" 31
1914	134,000	" 4		

From the showing in this table it is believed that a flow of 90,000 second feet or even more could be depended upon with reasonable assurance at the beginning and 80,000 at the end of the irrigation season, corresponding respectively to 830,000 and 750,000 h.p., or 350,000 and 270,000 h.p. in excess of the primary load of 480,000.

As shown in Fig. 6, the demand at the close of the season in 1912 was 50 per cent of the peak demand and in 1913 about 40 per cent. Moreover about 50 per cent of this closing demand in each case is represented by seepage and waste which would probably be eliminated as a matter of economy to a larger extent in a project irrigated by pumping, thus reducing this ratio of October demand to peak demand. The flow of the river, as shown by the hydrographs, is usually dropping through August, September and October, as is also the irrigation demand. No detailed study of their relative drop has been made, but from general inspection of the hydrographs and from the above figures it would seem that power could be developed for irrigation purposes without encroaching upon the primary capacity of the station, to the extent of about 250,000 h.p. at the close of the season, corresponding to at least 500,000 h.p. of June and July demand and requiring the installation of extra machinery of the latter capacity for its generation. The problem of space for canal and power station for this extra equipment is a very difficult and expensive one as will be discussed later.

Relation of irrigation load to secondary power load. It must be remembered that the use of surplus water above 50,000 second feet was contemplated for the generation of secondary power and that any development for irrigation would be in lieu of the former use or would at least so shorten the annual period of available secondary power that its commercial value would be doubtful. Moreover, it would require addi-

tional power house and equipment, whereas the former use would not.

Secondary power as auxiliary for existing electric service corporations. It so happens that nearly if not quite all of the small rivers in this territory which have been developed for power, experience their minimum flows during the months of August, September and early October, during which period surplus power in large amount would always be available at the power site under consideration. The use of any of this surplus power as auxiliary by the existing public service companies would affect only the fall period of surplus, but the spring surplus season would probably then be too short for the power to be of any commercial value. This prospective use as auxiliary is therefore in lieu of the use of an equivalent capacity for either irrigation or secondary manufacturing load.

A low and sustained minimum flow period is characteristic of most of the many smaller developed and undeveloped power streams in this generally mountainous region. This dry season is moreover coincident with the large demands made upon the ground water by the season of plant growth, and the resulting minimum is a serious obstacle to economical power development. Cheap surplus power from The Dalles should prove of great ultimate value to all other power development within its range of influence by thus increasing the economical generating capacities of existing and future stations on the smaller rivers.

Tramp life de luxe has been discovered near Marysville, California, in a "jungle" where a hobo has a home-made electric cooker, the "juice" for which he gets by hooking a wire to a third rail.

The cable bug is a small insect (sinoxylon declive) which, for purposes of concealment, bores small holes in the lead coverings of telephone and other cables. This insect ordinarily attacks wood but its damage to the lines of the Home Telephone & Telegraph Company of Santa Barbara, California, amounts to between \$300 and \$500 a month. The bugs are hard to find as they fly away. No effective means has yet been found of preventing their ravages.

A lightning flash may have a maximum current of more than 20,000 amperes, a frequency of from one hundred thousand to five hundred thousand cycles and a potential of at least half a million volts. No system of protection for oil tanks has been accepted by oil companies as giving protection commensurate with the cost. Lightning rods reduce the fire hazard by 80 to 99 per cent in the case of houses and by as much as 99 per cent in the case of barns.

Refillable fuses are not approved for general use by the Underwriters' Laboratory but as a result of an investigation by the U. S. Bureau of Standards the use of Economy fuses is "permitted by municipal and underwriters' inspection departments under conditions where their performance can be observed by each inspection department until sufficient experience regarding their performance under service conditions can be obtained to justify an unqualified approval or refusal to approve."

DIESEL ENGINE PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

Modern Engines.

In present day design, Diesel engines are divided into two classes, the vertical and horizontal. Each of these types has their advocates. In Europe there has been a general adherence to vertical engines and at present the greater number of American builders are following lead. In the vertical engine some manufacturers are using the open "A" frame construction while others have adopted the closed box-frame crank case. The advantages of these types, as claimed by the manufacturers, are accessibility of the "A" frame and cheapness of construction as against the more expensive and more rigid construction of the box type crank case. The matter of cleanliness and absence of vapors being blown from the crank case is also an argument advanced by the latter. Steam engineers in general are advocates of the "A" frame construction, and this type has been operated in America with entire success. On the other hand the operation of the enclosed crank case has also many advocates and has been proven by long experience. It has been adopted by the largest European builders and is preferred there, particularly for high speed engines. This type of construction, however, cannot be carried into extremely large sizes as the capacity of freight cars is limited, both as to the size and the weight of the casting which can be transported. It is usual with builders of "A" frame engines to enclose the working parts with some type of guards of sheet steel with small removable doors for observation.

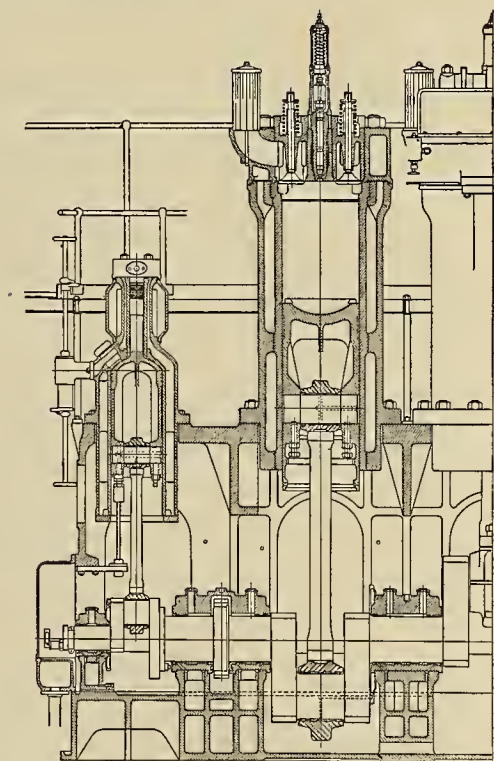


Fig. 11. Section of McIntosh & Seymour Oil Engine.

The McIntosh & Seymour engine is designed with "A" frame as shown in section in Fig. 11. The main bearings are lubricated by chain oilers. The cylinders are lubricated at two different points, one in the front and one in the back, from a mechanically driven sight

feed pump. The piston pin is provided with a separate lubricating pipe from the mechanical lubricator, which delivers its oil to a "V" shaped vertical groove in the piston; from this groove the oil is forced through a hole in the center of the wrist pin, whence it is lead to the bearings. The crank pins are lubricated by centrifugal oilers.

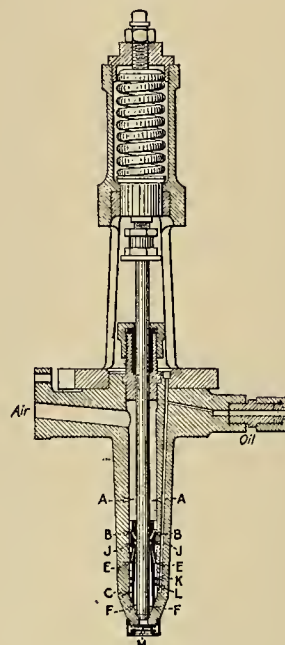


Fig. 12. McIntosh & Seymour Atomizer.

The atomizer is that invented by K. H. E. Hesselmann of the Aktiebolaget Diesels Motorer, (Swedish Diesel Engine Co.) shown in Fig. 12. Its essential feature is that instead of pulverizing the oil by crowding it down through perforated plates it draws it by the injector principle into the current of ingoing injection air, which atomizes and absorbs it as fast as it is drawn up. The charge of oil is deposited in a chamber, which it does not fill, even at an overload. Air is admitted to the chamber A-A and passes through the ports B-B, while it has also access to the oil chamber through the space E-E. When the fuel valve opens, the air, rushing through the port, passes through the expanding passage F-F, between the valve stem and the receding wall of the surrounding fitting, induces by injector action a difference of pressure which causes the oil to flow to the space, into which the oil, having been elevated and broken up through slotted plates K and L is drawn and picked up by the ingoing air. The form of the fuel plate has an important effect upon the efficiency of the atomizer.

The engine is started from a single cylinder. No attempt is made to relieve compression in starting as this is claimed to be unnecessary in engines below 500 h.p. Means are provided, however, for holding the exhaust valve open during the turning or barring of the engine by hand, preparatory to starting.

The cam shaft is located on the level of the heads, the cams not being housed. They are driven by a vertical shaft and screw gears. The rocker arms on these engines are practically alike, the rocker arm shaft being supported by steel pedestals fastened to the cylinder heads.

The variation of the quantity of oil pumped by

the fuel oil pump is accomplished by varying the stroke of the pump plunger eccentric operated off the vertical shaft.

The Lyons Atlas engine as built by the Lyons Atlas Engine Co. of Indianapolis, is unique, being truly of American design. It is not connected in any way with any European concern. The engine is of the "A" frame type, designed by Mr. Norman McCarthy. It is of the vertical, single-acting, enclosed type, with automatic lubrication, ample protection being supplied to the working parts by sheet steel covers. The base contains the housings for the main shaft bearings and also forms a reservoir for lubricating oil. The "A" frame for each crank is cast in one piece with the cylinder. It fits on the base, completely covering the crank pit. The main bearings are in halves, split horizontally. Each bearing is fitted with two ring oilers, the reservoir box being filled with splash in the crank case. The main shaft is a solid forging of open hearth steel, the cranks being fitted with counter-weights to absorb vibration. The connecting rods have solid upper ends, the lower boxes are babitted. The upper or wrist pin boxes are of phosphor bronze backed by a steel wedge. Adjustments can be conveniently made from the outside through side openings. The cylinder is provided with a liner cast separate from the cylinder proper. The heads are of close grained cast iron and are water jacketed, and can be removed without disturbing the valves. The pistons are of the long trunk type fitted with seven compression rings, no wiper ring being provided. A hardened steel wrist pin is ground to a perfect surface and firmly secured in the piston. The valves are in cages to permit of ready removal for regrinding. The splash system as well as the forced lubrication system is used by this company for lubrication.

The fuel injection pump is of the two-stage type, the first stage being directly controlled by the governor and serving to measure at the last instant before the beginning of each working stroke the exact quantity of oil that is to be admitted. This governing stage operates against pressure not in excess of atmosphere and is sufficiently sensitive in action to perform its important functions with the necessary quickness and accuracy.

The Lyons Atlas Company have built a 600 h.p. engine in four cylinders, this being the largest Diesel engine yet constructed in America. Two engines of this size were shipped to China and one of this size is in operation in the Hawaiian Islands. These engines have cylinders 21 in. by 30 in. stroke, developing 150 h. p. when operating at 164 r.p.m.

The Fulton-Tosi engine built by the Fulton Iron Works of St. Louis, is similar in most respects to the other A frame engines. The cam-shaft is on the front of the engine at the level of the cylinder heads. It is encased in a cast-iron housing for the full length of the shaft and the cams and gears operate in oil. The cam shaft is driven from a vertical shaft which also drives the governor and the fuel oil pump, bronze and steel spiral gears being provided.

The rocker arm slips off the end of the supporting rod without disturbing any other parts of the arm or head.

Variation in the quantity of oil delivered by the fuel oil pump is accomplished by maintaining a constant stroke of the pump plunger with a constant pump cylinder volume during the suction stroke and varying the pump cylinder volume during the delivery stroke. This is shown in Fig. 13. The method is in general use in America.

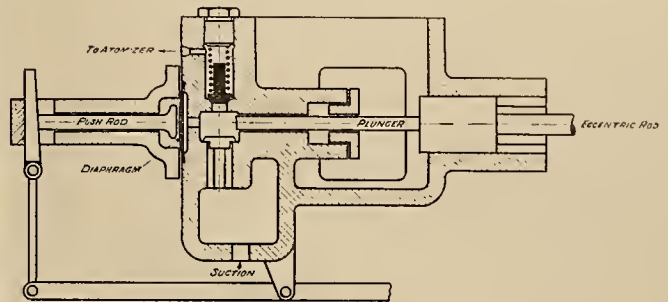


Fig. 13. Fulton Tosi Fuel Oil Pump.

Busch-Sulzer Bros. adhere strictly to the box type of construction up to 500 h.p. The engines (shown in section in Fig. 14) are of the box frame type with all parts under force feed lubrication—the cylinders, main bearings, cranks and wrist pins. The cylinders are lubricated at six different points by a sight feed mechanical lubricator. The main bearings, crank pins and wrist pins are lubricated with a positive displacement rotary pump located in the crank case and driven by gears from the main shaft. It takes its oil

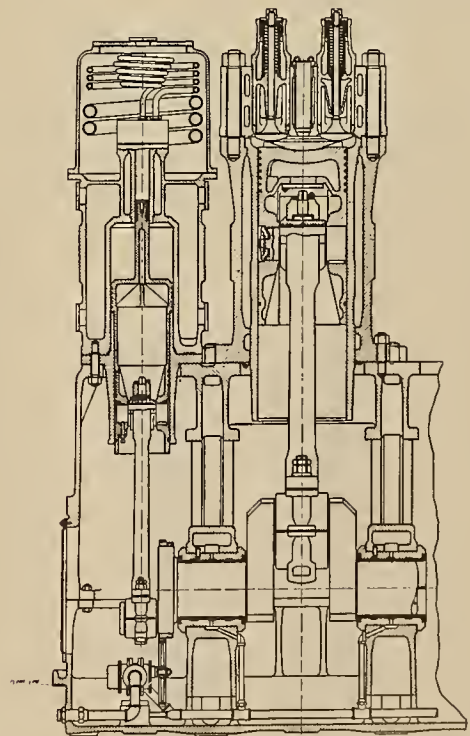


Fig. 14. Section of Busch-Sulzer Bros.-Diesel Engine.

from a filter and cooler below the floor line at the end of the engine. The crank shaft (see Fig. 15) and connecting rods are provided with a $\frac{3}{8}$ in. hole extending from the main bearing through the web to the center of the crank, the same sized hole extending through the entire length of all connecting rods both for working cylinders and compressor. Fifteen pound pressure is maintained on the lubricating oil by the

rotary pump and a gauge in plain sight of the operator indicates the pressure.

The atomizer is that employed by Sulzer, and, in type at least, by most of the Diesel licensees, as shown in Fig. 16. The charge of oil for the coming stroke is delivered to the chamber, which is continuously in connection with the bottle containing the high-pressure injection air. At the bottom of this chamber are disks with perforations which do not register, so that when the fuel valve opens, the oil coming through one of the perforations of the top plate is driven against the solid portion of the next plate with a velocity induced by a difference of pressure of some 400 lb. at a maximum and it is broken

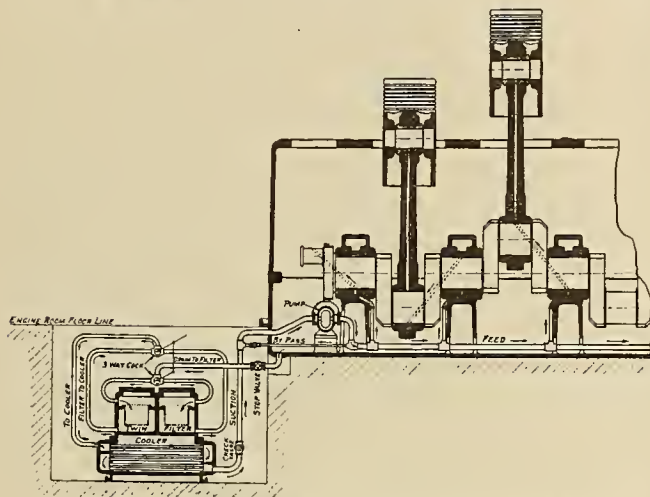


Fig. 15. Lubricating System of Busch-Sulzer Bros. Engine.

up into a spray, in which form it is swept through the successive places, becoming finally atomized. The truncated cone below these disks is grooved on its outer surface, and the oil-laden air passes through these grooves and is directed against the edges of the

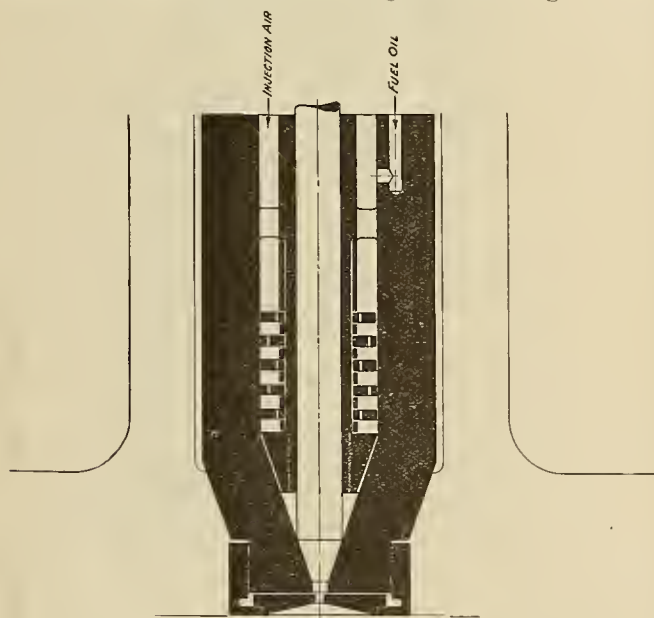


Fig. 16. Sulzer Atomizer.

opening in the nozzle plate in such a manner that its stream upon entry into the combustion chamber is spread into a saucer-shaper, umbrella like flame all over the surface of the piston. These engines are equipped with removable cylinder liners.

The engine is started from two center cylinders and is furnished with a mechanical device for simultaneously releasing compression on all cylinders by means of an additional cam which opens the exhaust valve on the compression stroke.

There are six compression rings and one wiper ring. This latter is a knife edge ring which is very efficient and effects a great saving in lubricating oil.

The cam shaft of the Busch-Sulzer engine is on the front of the engine at the level of the cylinder heads. It is encased in a cast iron housing the full length of the shaft and the cams and gears operate in oil. The cam shaft is driven from a vertical shaft which also drives the governor and fuel oil pump. Bronze

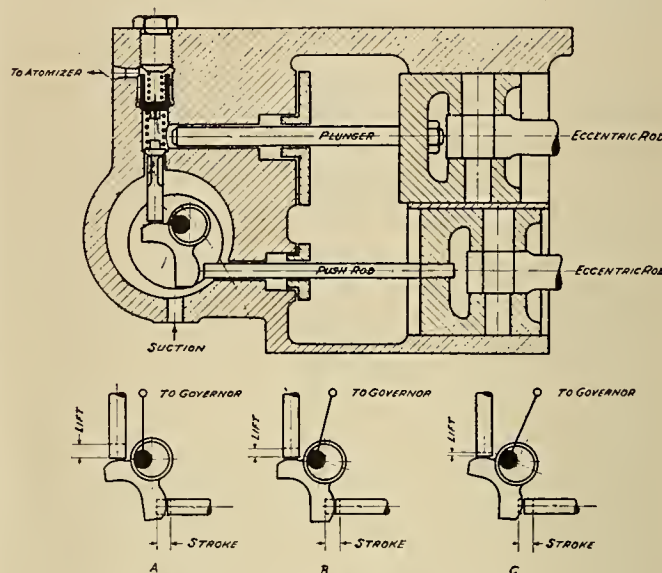


Fig. 17. Busch-Sulzer Fuel Pump.

and steel spiral gears are provided to drive the vertical shaft and the cam shaft. The rocker arm is in two parts and is claimed to permit of easy removal of the valve cages, particularly the exhaust valve.

The fuel pump is similar to that in general use in Europe and operates by what is known as the "by-pass" method. This by-passing is accomplished by holding open the suction valve of the pump during a portion of the delivery stroke. Both the plunger and the push rod have constant strokes but the action of the bell crank operated by the push rods is varied by its eccentric mounting, which is rotated under governor control; so that the suction valve of the pump is held open during the longer or shorter portion of the delivery stroke of the plunger. This is illustrated by Fig. 17.

Diagram "A" shows the parts in no load position, the suction valve being held open almost throughout the entire delivery stroke. "B" and "C" respectively show the parts in half and full load positions.

[To be continued.]

Substituting copper for aluminum conductors, because the present high price of aluminum made the exchange profitable, was recently undertaken by the power company supplying Rochester, N. Y. The change was made on the basis of aluminum at 56 cents and copper at 20 cents per pound, \$84,000 being the profit from the sale of 63,000 lb. of aluminum in 2.2 miles of 428,000 circ. mil. duplicate three-phase line.

STEAM CONDENSERS AND CONDENSER TUBES.

BY A. F. C. WOOD.

(After the function of the condenser is simply explained, suggestions are given for minimizing corrosion of condenser tubes, including detailed directions for making photo-micrographs. The author is superintendent of generation for the Southern California Edison Company, from whose monthly magazine this article is taken.—The Editor.)

The steam condenser in a power plant is used, as its name implies, to condense the steam after it has gone through the engine or turbine. Two objects are secured by so doing, the pure water from the condensed steam is saved and can be used over again in the boilers, and more power is obtained from the same amount of steam, because not only does the high pressure steam push the turbine round, but the vacuum caused by condensing also pulls it round in the same direction.

As a matter of fact, a turbine delivers practically twice as much power condensing as when non-condensing with the same amount of steam, and furthermore returns all the steam as water, beautifully pure, that will not scale up the boilers.

Were it not for the condenser, a supply of fresh water for the boilers would be required at least fifteen times as great as that which we now use, and for the same load we would burn about twice the fuel oil, and this would not be all, for we would require twice as many boilers and turbines and buildings nearly twice as large.

Although it is not spectacular and has no revolving parts, and appears to be but a cast iron shell to casual inspection, realization of the above facts will lead to an appreciation of how important is this adjunct to the turbine.

The condenser on our 27,000 h.p. number three turbine at the Long Beach steam plant contains 7530 brass tubes, each 1 in. in diameter and 17 ft. 2 in. long, so that if placed end to end they would extend for twenty-five miles, and they weigh fifty tons.

Water is pumped directly from the ocean through all these tubes to keep them cold, and it is upon their 36,000 sq. ft. of surface that the steam coming from the turbine is condensed.

Every twenty-four hours 244,500 tons of sea water is pumped through this condenser, or enough to flood a city lot 50 ft. by 150 ft. to a depth of over one thousand feet; seven times the height of our tallest office buildings.

The tubes carrying all this water in the chamber are made of a brass of a special composition and are only one-sixteenth of an inch thick in the wall. Should they become damaged to the extent of leaking, the sea water will pour through the leak and contaminate the condensed steam, rendering it unsuitable for further use. For this reason every precaution is taken to reduce these leaks to a minimum by constant testing of the condensed steam, to see if salt has entered it; if so, the condenser is tested until the faulty tubes are found and either plugged temporarily or replaced by perfect ones.

Like most other things, tubes are afflicted with diseases; the best that can be hoped is that they will gradually waste away, dying of old age, when they

become worn so thin that they can no longer hold together, but it may be that the violent disease called "pitting and corrosion" attacks them, they wear out in spots, and holes are formed long before the tube, as a whole, has become too thin for service. Such tubes may be sent to the tube doctor and the hole patched up, but the disease is not eradicated and other holes soon occur, and shortly the whole tube has to be thrown away.

A great deal of research has been expended upon trying to discover the real cause of corrosion and its remedy. Various different kinds of alloys have been experimented with, both in the laboratory and in actual practice, but as a good tube should last at least five or six years in land plants, and considerably longer in ocean going vessels, the practical determination of the best methods takes a long time.

All the authorities are agreed that the alloy known as "Admiralty mixture" is the best that we know of at the present time. It is composed of 70 parts of copper, 29 parts of zinc, and 1 part of tin. Having made up their minds that this was the best mixture to use, the research committees and users of condenser tubes adopted it as the best solution, but the users of tubes found it was not settled at all, for of two lots of tubes, both Admiralty mixture, one would last for years and the other for only as many months.

The committee on Steam Turbines of the Association of Edison Illuminating Companies finally came to the conclusion that the difference between a good tube and a bad one lay in the manner in which it had been treated in the mill, and that in order to get the best results the tubes should be given a careful annealing at a certain temperature and it appears to be as necessary to give these tubes the right temper as it is to temper steel according to the use to which it will be put.

In our own practice we have had a perfect illustration of the difference that there may be between tubes of apparently the same kind. At Long Beach steam plant we have three turbines, each with its own condenser.

The tubes in Number One turbine, now over four years old, are aging gracefully, thinning down it is true, but doing so uniformly, and will no doubt last one or two years more.

The tubes in Number Three condenser have pitted terribly and they are only eighteen months old. The reason is that the tubes in Number Three condenser were not properly annealed, the evidence being that they were over-annealed. Just as a good machinist or tool maker can tell a great deal about the quality of his steel by noting the size of the crystalline grain when the metal is broken, so it is possible to determine whether brass tubes have been properly annealed by noting whether the grain is fine or coarse.

To bring out the grain in brass and other soft metals, the metal is polished, emery paper of increasing fineness being first used, and then polishing powders, finishing up with jeweler's rouge. The polished surface must be so perfect that even under a microscope it will be impossible to detect any scratches; it is then etched with a suitable acid or reagent when the crystalline structure becomes apparent. The most

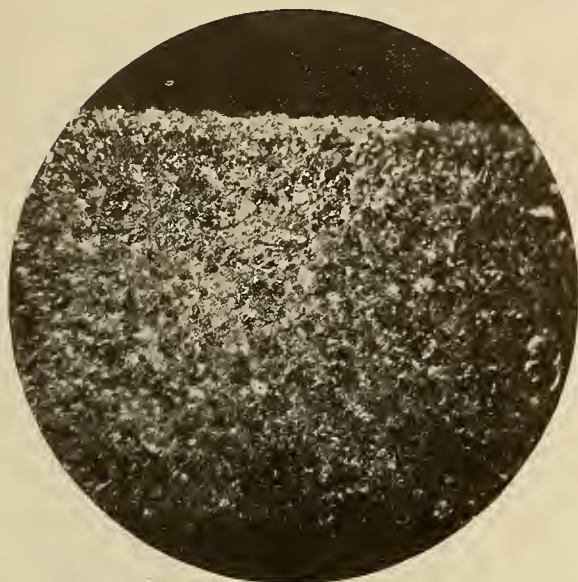
durable tubes have a fine grain similar to that shown in the cut which was made from a tube out of Number One condenser at Long Beach steam plant.

The illustration of a coarse grained tube is made from one out of Number Three condenser and shows the great difference between the two tubes.

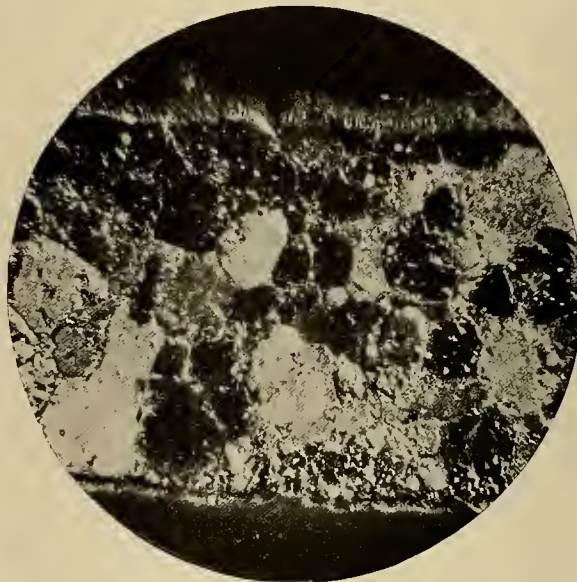
The cut of an overheated tube shows the result of heating a fine grained tube red hot and quenching.

that it is not a difference of composition that causes one crystal to look light and another dark.

These three photomicrographs are all magnified fifty diameters and were made by the writer after much tribulation, as the work was new to him. It may be of interest to those readers who are photo fiends, and we nearly all are to some extent, to describe how these photomicrographs are made.

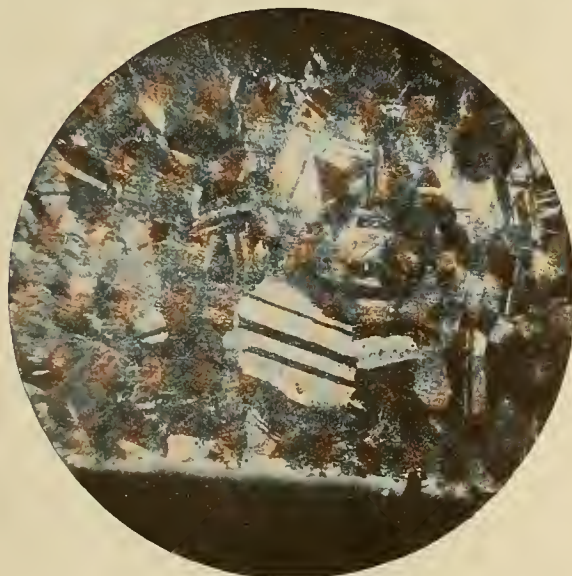


Section of Tube taken from No. 1 Condenser showing Fine Crystalline Structure.



Section of Tube of Originally Fine Structure showing Effect of Overheating and Quenching.

The light and dark crystals as shown in these photomicrographs are not of different composition; it might be thought that the dark areas had more copper in them and the light ones more zinc. This is not so, the difference in appearance of the crystals being due



Section showing Crystalline Structure of a Tube taken from No. 3 Condenser.

A microscope and an ordinary view camera are required, but no lens is needed with the latter as the microscope lenses take its place. The microscope is inclined so that its tube is horizontal and points into the camera where the lens usually is; the whole arrangement of microscope and camera goes very nicely upon a good solid dining room table; between meals. The space around the microscope tube should be filled in with an extemporized front board to keep out extraneous light. The light from a 40 or 60-watt tungsten lamp with frosted globe must be concentrated on the section of brass tube by means of a bullseye lens. With such an arrangement using a Seed Ortho L plate, the exposure required will be of about two minutes.

To revert to tube corrosion, it appears from our experience that corrosion starts in between the crystals, and that when a crystal has been corroded all around it becomes loose in its socket, so to speak, and gets washed away by the water. The larger the crystals and the less uniform in size they are, the quicker we might expect the tube to wear out, and the more likely it should be to break down in spots and make holes. Again the larger the crystals that fall out the rougher the inside of the tube becomes, and the water has a greater hold upon it and wears it more rapidly.

There is another possible cause of tube corrosion about which there is a great diversity of opinion.

It is claimed by some that small particles of cast iron become detached from the piping in the plant through which the water is taken and these particles settle in the tubes and make a little galvanic couple

to the fact that they reflect the light in different directions. If instead of throwing the light on to the specimen from one side it is reversed and directed from the other side, the light and dark areas change places, what was light before is now dark. This clearly shows

together with the brass, and that the brass gets eaten up in this way. The proponents of this theory base it chiefly upon the fact that in many cases the pitting of tubes is nearly all along the bottom of the tube.

The opponents, however, state that they have purposely put such particles into condenser tubes and found that they corroded less with the particles in them than they did before. The answer apparently is that there are particles—and particles.

Another cause for corrosion is electrolysis, where return currents from street railroad systems elect to go home by way of the condenser tubes. This form of trouble has been partly neutralized by connecting up a low voltage dynamo to the condenser in such a way as to oppose the stray currents.

This arrangement has also been proposed as a cure for all tube corrosion troubles and a certain case came to our attention where most remarkable results attended the installation of one of these systems; in fact, since it has been started not a tube had been lost. Success seemed assured. Shortly afterwards it was discovered that the low voltage machine had all the time been connected up backwards, and was helping the stray currents instead of neutralizing them. Evidently a case of faith cure.

ANNUAL REPORT OF THE BUREAU OF STANDARDS.

The annual report of the Director of the Bureau of Standards, Department of Commerce, gives an interesting account of the activities of that Bureau during the fiscal year 1915. The standards with which the Bureau has to deal are standards of measurement, standard values of constants, standards of quality, standards of mechanical performance and standards of practice. The relation of the Bureau's work to the public is clearly discussed, especially the Bureau's part in aiding industrial progress. During the year, 154,000 tests were made and 1,800,000 lamps inspected at the factories.

Color standards, the development of energy-measuring instruments sensitive enough to measure the heat of the stars, studies of the causes of failure of railway materials, exact determination of the data required in the refrigeration industries, and other important researches have made excellent progress during the year.

Of special public interest were the tests of railroad track scales, tests of parcel post scales, the work in methods of precision temperature measurements, with special reference to the refrigeration industries and the measurement of high temperatures and fire resisting properties of building materials.

Of particular interest to manufacturers and testing laboratories are the Bureau's investigations of industrial materials, such as metals, clay products, glass, cement, textiles, papers, rubber and paints. The Bureau issued 47 new publications during the year.

Of special interest to the people is the work of the Bureau in connection with public utilities, particularly in establishing definite standards of service, preparing safety rules, assisting in local studies as to service, acting as referee in cases of dispute and serving as a clearing house of information on all public utility and

associated engineering questions, helping to secure uniform methods of accounting where public service commissions are not yet established, and getting out laboratory tests and investigations to answer difficult answers connected with the telephone, gas, electric light and power, electric railway transportation, and miscellaneous utilities other than steam railways.

ELECTROLYSIS MITIGATION.

Among the more important conclusions brought out in Technologic Paper No. 52 of the U. S. Bureau of Standards are the following:

By far the greater portion of the damage due to electrolysis is that arising from corrosion of underground pipes and cables. Electrolytic damage to concrete structures is to be feared only where voltage conditions are exceptionally severe, or in the case of comparatively low voltages when salt has been added to the concrete either during or after construction.

In general, those remedial measures that are applicable to pipe systems should be regarded as secondary means of mitigation of electrolysis trouble, the principal reliance being proper construction and maintenance of the railway return circuit. In special cases, however, mitigative measures may be applied only to the underground structures.

Of the mitigative measures applicable to pipes only a few of those that have been advocated have found much application. The two most commonly applied are the installation of insulating joints and the use of pipe drainage. In most cases these systems should be restricted to use as auxiliary means of protection, after reasonable precautions have been taken to reduce potential drops in the tracks to as low values as are economically practicable. In any case where pipe drainage is used, the drainage should be through the medium of insulated feeder systems, so adjusted as to take the minimum possible current from the pipes at all points.

Of the methods applicable to railways the most important of those which have been thoroughly tried out are the adequate maintenance of track bonding, the use of a proper number and location of power houses or substations, and, where the carrying capacity of the rails is not sufficient to return current to stations without excessive drop, the use of insulated negative feeders for the return of such current, these latter being much more economical than uninsulated feeders where large reductions of potential drop are required. The three-wire system has proved effective in relieving electrolysis and should prove satisfactory from the electrolysis standpoint where operating conditions are favorable to its use.

Such remedial measures as have been adopted in this country have usually been applied to the pipes, and in general they have proven much less effective than measures used in certain foreign countries where regulations limiting voltage drops in the negative return have long been in effect and have been accompanied by substantial freedom from electrolysis troubles. Experience both here and abroad indicates that such limitation of voltage drop is necessary to a satisfactory solution of the problem.

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POWER AND GAS

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Since most authorities are now agreed that public utility rates should be predicated upon the value of the property used and useful in furnishing the service, the first problem of rate making is evaluation. So many conflicting ideas exist regarding the proper methods of evaluating public utility properties and so many bitter controversies have arisen on this subject that it seems high time to revert to fundamentals. What is value?

Strange, indeed, does it seem that after all these centuries of civilization no one has been able to propound a satisfactory definition of this five lettered word. Mathematically speaking, it is a simple ratio between the article valued and money. But there are so many factors which enter into a determination of this ratio that it becomes exceedingly complex.

Yet there are a few basic principles which tend to clear this much-befogged issue and by keeping them in mind it is possible to steer a straight course. Disregarding all other purposes of valuation except for rate-making purposes, the value of a public utility plant depends upon the point of vision. Two points of view have been given much prominence of late.

One, known as the agency theory, considers a public utility company as the agent of its principal, the public. It regards an electric light and power company, for example, as "springing full-panoplied from the brow of Jove" as did Minerva, an organism which contravenes all recognized processes of growth. Under this theory, valuation for rate-making is ordinarily determined from past costs of building the physical plant.

The other, known as the competitive theory, assumes a gradual, natural growth against contending circumstances, a development such as characterizes any normal animal or plant. From this view-point, value is based upon the cost of reproducing a similar organization under present conditions.

The proponents of neither of these two distinct theories claim that the mere cost, whether the original cost or the cost of reproduction, represents the entire value of the property. There are other elements, the so-called intangibles, which also enter into the equation. Both sides recognize that an inventory of physical equipment does not constitute the value of an established utility, any more than does the physical appearance of a man represent his true worth. The two theories, however, vary widely in their estimate as to the value of the intangibles, and it is upon this rock of contention that many experts disagree.

Without entering into an extended discussion of the merits of these two theories, common sense would suggest that the greatest weight be given to that which most nearly corresponds with the actual conditions under which the plant was built. Most companies have been established under the stress of competition, and so should be entitled to a valuation based upon such competitive conditions.

It is possible that time will change this, that in the future the public utility will act solely as the agent of the public it serves. But even in this case, the theory of agency should not be made retroactive.

Such, at least, is the view of engineers who have built plants. While it does not harmonize with the opinions of many lawyers and political economists, it must be remembered that a legal decision can always be found to bolster up any argument, as court decisions change with the times, whereas engineers deal with conditions which have existed since the beginning of time. Surely the engineer, a man who spends hours on the details of an electric light and power system, is better qualified to pass on its value, than a lawyer or a political economist who spends minutes on the subject and who knows nothing of practical operating difficulties.

When Secretary Daniels announced that the Naval Consulting Board is to be augmented by the appointment, as assistant members, of a representative for each state in the Union from the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers, the American Institute of Mining Engineers and the American Chemical Society, he pointed out that these five engineering organizations represent a membership of 36,000 men, "particularly fitted to perform this class of work in an intelligent and disinterested manner." This public recognition of the value of the engineer is gratifying and forms the incentive to be of even greater service. Whether the nation-wide compilation of data proposed presages preparedness for peace or preparedness for possible war it is manifestly in accordance with the first principles of national efficiency.

The immediate purpose in gathering together all this information about the country's producing and manufacturing resources is to furnish records upon which to formulate plans for defense. While the compilation of these data may seem an irksome task, they are an essential preliminary to any efficient action. Undoubtedly many engineers will be called upon to help in this work. Let them therefore be found ready and willing to give their assistance.

The great majority of engineers are graduates of universities where military training is required. Many of them have been commanding officers and are thoroughly acquainted with the details of military organization. Such military knowledge, combined with their engineering training, admirably fits them for positions in the army.

Instead of increasing the facilities of the military academies, whose every graduate costs the government twenty thousand dollars, the machinery of existing state universities might well be utilized. Additional stress would be necessary on the military side, a stricter discipline would have to be enforced, and a more democratic standard of living set. This, incidentally, would greatly improve the product of many

of our colleges, where snobbishness inculcated and encouraged by false standards. The plain life of the barracks, the strict supervision and the enforced restraint are sadly lacking in American universities as a whole. From the technical standpoint, however, these graduates, after proper practical experience, are eminently qualified to advise with the army officers.

Modern warfare is essentially an engineering problem. Formerly both army and the navy men arrogated to themselves sole knowledge in these matters. Recently, however, they have shown a desire to call consulting engineers into their councils. Even in such highly specialized branches as constitute the national defense the advice of experienced engineers in others lines of work is most valuable.

The individuality of the store has long been recognized as an asset. Pirates have frequently tried

Individuality In Lighting

to copy the individuality of those stores having successful management and pronounced public patronage, thus proving that such individuality is of value. One of the strongest factors in a store's individuality is lighting. Lack of individuality in store lighting constitutes a rebuke to the lighting expert, engineer and fixture dealer, though criticism should be tempered because of the callousness of commercialism.

If fixture manufacturers were a unit actively participating in nation-wide educational movements and had also fostered from the first an appreciation of that which is artistically correct, individuality in lighting would now be practiced as a desirable art and the fixture business for both manufacturer and dealer be on a better or more profitable plane than it is at present. It is true that when commercial or any other form of lighting runs excessively to type, the revulsion causes an appreciation of individuality with the result that the typical installation is thrown into the discard and new and more suitable equipment installed. Herein lies the aesthetician's opportunity.

But to have electric lighting properly appreciated all unwise expenditures on the part of customers must be prevented and difficult though at times this may be, he must be taught to appreciate individuality in lighting and to make expenditures proportionate to its added value and permanence. Properly presented, its influence must be felt by the prospective purchaser just as the actual installation will be later by his patrons.

And all this is especially true, if the lighting (fixtures and methods), rounds out as it is supposed to do, the ornamental and decorative features of interior furnishings.

The day of big blue beads, strings of teeth and feathers as ornaments has passed, as has also the monotony of a single type. Welcome the lighting aesthetician who will introduce into his craft the utmost individuality.

PERSONALS

F. Van Vleck, formerly with the Bristol Company, has returned to Los Angeles.

C. R. Downs, general manager of the Amador Light & Power Company of Sutter Creek, Cal., is at San Francisco.

A. M. Irwin, assistant to the treasurer of the Westinghouse Electric & Manufacturing Company, is visiting Arizona.

Bert Hansen, formerly with the A. G. Electric Company, has joined the sales force of the H. B. Squires Company at San Francisco.

Paul Lebenbaum, electrical engineer for the Portland, Eugene & Eastern Railway Company of Portland, was at San Francisco this week.

R. H. Thomson, former city engineer of Seattle has been engaged by the city of Aberdeen, as consulting engineer of the Wishkah water project.

M. M. O'Shaughnessy, city engineer for San Francisco, is at Washington, D. C., to oppose the granting of a power permit to the Yosemite Power Company.

M. L. Scobey, formerly salesman with the Pacific States Electric Company, now has charge of the General Electric Construction Company at San Francisco.

P. M. Downing is inspecting the tunnel work of the Pacific Gas & Electric Company at Chippier, Gap, Cal. He reports 11 ft. of snow at Drum Power House.

Harry L. Vorse, assistant electrical inspector of the Underwriters' Equitable Rating Bureau at Portland, is confined to his home with a severe attack of grippe.

Frank M. Greenwood, for years prominently identified with the electrical industry in California, has become president of the Gas & Electric Appliance Company of San Francisco.

Geo. F. Fuller has resigned as U. S. inspector of boilers at Portland, after 17 years of service. He will be succeeded by **John E. Wynn**, assistant inspector of boilers at San Francisco.

E. O. Sessions, of the General Devices & Fittings Company, has returned to Chicago, after a visit to the Pacific Coast. He expects to again be in Portland soon after the first of February.

Walter M. Berry has resigned as chemist and superintendent of plant for the Portland Gas & Coke Company to become assistant gas engineer with the U. S. Bureau of Standards at Washington, D. C.

Edwin T. McMurray has been elected president of the Petaluma & Santa Rosa Railway and **E. H. Maggard** general manager to succeed the late E. M. Van Frank, who was president and general manager.

Saburo Oshida, electrical engineer of the Department of Communications of the Imperial Japanese Government of Tokio, is making a study of the electrical industry in the United States, now being at San Francisco.

F. H. Woodward, Oakland manager of the Great Western Power Company, and **Romaine W. Myers**, electrical engineer, are members of the committee on electrical display for the "ad-masque" to be held February 14th at Oakland, Cal.

Lloyd N. Robinson, formerly a member of the field staff of the joint committee on inductive interference of the California Railroad Commission, and recently in the engineering department of the Pacific Light & Power Company of Los Angeles, has been appointed instructor in electrical engineering at the University of California.

Frank J. Gleiss, testing and general efficiency engineer with the Pacific Gas & Electric Company, San Francisco; **Septimas Parker**, operator with the Pacific Gas & Electric Company, San Francisco; **Henry C. Stanley**, engineering department General Electric Company, San Francisco, and **Albert P. Strout**, operator with the Northern California Power Company, Manton, Cal., have been elected associate members of the American Institute of Electrical Engineers.

OBITUARY.

John H. Carr, manager of the Valley Electric Company of Fresno, California, passed away at Fresno on January 11, 1915.

MEETING NOTICES.

Los Angeles Jovian Electric League.

With H. H. Harrison, proprietor of the Commercial Electric Garage as chairman of the day, the league lunch on January 12th was a great success. Aside from some unusual vaudeville entertainment he introduced two headline speakers. **Sylvester L. Weaver**, president of the Rotary Club of Los Angeles, told "What Rotary means to the Average Business Man," and **Willis H. Booth**, of Hot Point fame, and also vice-president of the Security Trust & Savings Bank, gave a masterly address on "Trade Conditions of the United States."

Oregon Society of Engineers.

The regular monthly meeting of the Oregon Society of Engineers was held in the Public Library Building, Portland, at 8 p. m., January 13th. The speaker of the evening was **Mr. Charles Evan Fowler**, M. Am. Soc. C. E., of Seattle, Wash. He illustrated his talk on "The Architecture of Notable Bridges," by about 200 lantern slides. An amendment to the constitution was proposed to be voted upon at the regular annual meeting, February 7th, to provide a students membership to the society with an annual dues of \$1 per member.

San Francisco Development and Jovian League.

E. M. Cutting, president of the league, set a fast pace in introducing **Fred H. Leggett** as chairman of the day for the league lunch on January 12. Mr. Leggett had provided a "dago band," which dispensed some rollicking music before the introduction of **Frank I. Turner**, president of the Downtown Association and of the Exposition Preservation League, as speaker of the day. Mr. Turner told of the various plans which had been made for preserving the Palace of Fine Arts, the Hawaiian Building, the California Building, and the Oregon Building, as well as the system of boulevards. **Geo. C. Holberton** also told of the plans for a recreation park for the use of the Pacific Service Section of the N. E. L. A.

Portland Sections A. I. E. E. and N. E. L. A.

The regular meeting of the Portland sections of the A. I. E. E. and N. E. L. A. was held January 11th, at 8 p. m., in the assembly hall of the Electric Building. The meeting was held under the auspices of the local section of the A. I. E. E. with **Mr. Paul Lebenbaum** as chairman. The subject of the meeting was "Inductive Interference," between power circuits and telephone lines. The paper of the evening was presented by **Mr. R. W. Mastick** of the Pacific Telephone & Telegraph Company of San Francisco. This was followed by a short talk by **A. H. Griswold**, plant engineer of the Pacific Telephone & Telegraph Company of San Francisco. An exceedingly spirited discussion followed, which was entered into by Messrs. **J. E. Martin**, Pacific Power & Light Company, Portland, Oregon; **J. B. Fiske**, Washington Water Power Company, Spokane, Wash.; **F. D. Nims**, Olympic Power Company, Port Angeles, Wash.; **V. H. Greiser**, Washington Water Power Company, Spokane, Wash. After adjournment the members present were served "hot dogs" cooked on an electric range. Attendance 78.

TRADE NOTES.

The Crossett-Western Lumber Company of Wauna, Ore., H. S. Mitchell, manager, has contracted with Hunt, Mirk & Company for the installation of an 1875 k.v.a. Westinghouse high pressure turbine with LeBlanc condenser and 2000 h.p. in motors for the electric operation of the mill.

The Underwriters' Laboratories, Inc., are now examining material and devices as regards their value as "safety first" devices. The first cards are now being sent out on same to the various subscribers to the card index system. The classification is as follows: Anti-slip material, treads, metal working, guarding appliances, wood working, locking devices, elevator, machinery, scaffolding, wearing apparel, goggles.

NEW "EXIDE" DEPOT AT LOS ANGELES.

Kay & Burbank Company, distributors for the "Exide" Starting and Lighting Battery, in Southern California, who for years have been operating an electric garage in Pasadena, have been distributing "Exide" products from that place, have found it necessary for the convenience of their customers, and also owing to the increase in their business, to open up an "Exide" battery depot and service station at Eleventh and Figueroa streets, in the heart of the automobile district of Los Angeles.

The front part of the building is occupied by the office, and a large, well-kept battery stock room, where is carried one of the largest stocks of batteries and parts, on the Coast. In the rear of the building, with entrance on Eleventh street, is housed the battery service department, and the electrical department, where electric vehicle, ignition, starting, lighting and magneto work is taken care of.

NEW CATALOGUES.

The Western Electric 1916 Electrical Supply Year Book is a comprehensive catalogue of over 1500 pages, 7x9½ in., including all standard electrical apparatus and supplies. It follows the admirable precedent of a uniform list price and discount plan which was introduced as an innovation last year.

Catalog No. 4, of the Electric, Railway & Manufacturers' Supply Company of San Francisco, completely lists Westinghouse electrical apparatus carried in Pacific Coast stock. The book contains 221 pages, 6½x10 in., and includes valuable suggestions to dealers regarding methods of selling electric household appliances.

CALIFORNIA PUBLIC UTILITIES ACT IS UPHELD.

Two decisions upholding orders of the Railroad Commission of California have been filed by the Supreme Court of California. They concerned the Marin Water & Power Company and the California Development Company. In the Marin Water & Power Company case the Supreme Court passed upon the validity of the provisions of the Public Utilities Act, empowering the Railroad Commission to fix the value of public utility property in eminent domain proceedings. This provision permits any city or water district or other municipal corporations to ask the commission to fix the value of the property of any public utility which it desires to purchase.

The Marin Municipal water district asked the Railroad Commission to fix the just compensation to be paid to the Marin Water & Power Company for the latter's property. The commission fixed the value at \$1,200,000. The company appealed to the Supreme Court to overthrow the commission's decision, claiming that the commission had no authority to fix the value, and, further, that the value fixed was too low, and thus deprived them of their property without due process of law. The company also claimed that the commission should have made a separate finding of value for each item

of the property, instead of an aggregate value for the entire property. The decision of the Supreme Court, which upholds the commission's order, opens the way for the district to proceed to acquire the properties of the Marin Water & Power Company at the price fixed by the Railroad Commission.

PUBLICATIONS RECEIVED.

Reports of the Board of Engineers Flood Control to the Board of Supervisors, Los Angeles County, Cal., recommending conservation of storm water through reforestation and retarding work in the mountains, spreading of storm-waters in the gravel deposits at the mouths of canyons, acquisition of official channels for the principal streams, and diversion of the Los Angeles and San Gabriel rivers to Alamitos Bay. Copies may be obtained from J. W. Reagan, Chief Engineer of Flood Control, Hall of Records, Los Angeles.

Water Power Projects, Telephone, Telegraph, Power Transmission Lines on the National Forests. Regulations of the Secretary of Agriculture and instructions regarding applications for permits for water power projects under the Act of February 15, 1901, and for easements for telephone, telegraph and power transmission lines under the Act of March 4, 1911.

Technologic Paper No. 52, U. S. Bureau of Standards. "Electrolysis and Its Mitigation." By E. B. Rosa and Burton McCollum.

BOOKS RECEIVED.

The Principles of Dynamo Electric Machinery. By Benjamin F. Bailey, 314 pp., 6x9 in. Published by McGraw-Hill Book Company, New York City, and for sale by Technical Book Shop, San Francisco. Price \$3.00.

Considering the large number of text books on this subject the first question which arises is why another. The answer is found in the manner of presentation. The physical phenomena which take place in electrical machinery are clearly described, the mathematical demonstrations being subordinated. As the result of his experience as professor of electrical engineering at the University of Michigan, the author shows what the machine will do and why it does it. Direct current motors and dynamos, together with systems of distribution, characteristics, rating, efficiencies, losses, measuring instruments and accessory apparatus are first discussed. Then alternating currents are simply explained, inductance and capacity effects made clear and measuring instruments illustrated. Finally the transformer, synchronous machine, rotary converter, induction motor, and single-phase commutator motor are each discussed in detail as to theory and operation. This is an excellent introductory text for any college student of electrical engineering.

"Industrial Uses of Fuel Oil," by F. B. Dunn; 235 pp.; 5½ x 8½ in.; 110 illustrations. Published and for sale by Technical Book Shop, San Francisco. Price \$3.00.

This text constitutes a practical guide concerning the possible use of fuel oil in any sort of an industrial plant. It differs from the usual published information in that it not only discusses the properties of oil, its storage, furnace arrangement and methods of burning, but also gives practical suggestions for its application in various manufacturing plants—clay, lime and cement, glass, locomotive, sugar, rubber, smelting, shops, steel, maritime and domestic purposes. Special attention is given to the rotary system of burning oil and there is an extended treatment of furnace efficiency and combustion. The chapter on tests and reports is particularly complete. A final chapter is concerned with oil for gas making. This is an excellent work for any steam engineer, architect, plant superintendent, manager or fuel oil salesman, as it brings into compact form all that is essential in determining the possibility of using oil as a solution of the fuel problem. It is written in a practical manner for the use of practical men.



NEWS NOTES



INCORPORATIONS.

SAN FRANCISCO, CAL.—E. H. Electric Company, San Francisco, \$20,000; shares \$5 each, subscribed, \$15, by J. A. Hunt, F. I. Ellert and W. M. Brownlie.

SAN FRANCISCO, CAL.—The Pacific Gas Appliance Company, San Francisco, \$75,000; shares \$100 each, subscribed \$4500, by M. J. Purcell, S. F. Chase and Eliza A. Nordman.

ILLUMINATION.

BERKELEY, CAL.—The city council has set January 25th as the date for calling bids for the new lighting system.

HUGHSON, CAL.—Construction of a street lighting system is proposed by the board of trade. L. C. Quimby is interested.

COULEE CITY, WASH.—The merchants of Coulee City are organizing a stock company to put in water works and electric lights.

OREGON CITY, ORE.—Mayor Hackett is in favor of a municipally owned light and power plant utilizing the city right to power from Willamette Falls.

REDDING, CAL.—City Electrician E. Rolison has been authorized by the trustees to make the first purchase of materials for the new street lighting system in the sum of \$1100.

AZUSA, CAL.—The board of trustees has awarded the contract for the installation of a lighting system on portions of Pasadena avenue, Sunset avenue and certain other avenues, to the F. O. Engstrum Company at \$7140.

LOS BANOS, CAL.—Application has been filed requesting the board of trustees to grant a franchise to construct a gas plant and lay pipes to convey gas to dwellings. Sealed bids will be received for said franchise up to February 19th.

TUCSON, ARIZ.—Plans for the construction of new water and electric plants for the city will be submitted by Sidney F. Mashbir, and it is anticipated that work will be started within sixty or ninety days. The lighting will consist of two units.

PASADENA, CAL.—The city commission has awarded the contract for street lights on Colorado and certain other streets, to the F. E. Newberry Electric Company at \$3728, and the contract for lights on Raymond avenue to the Southern California Edison Company, at \$2386.

TRANSMISSION.

GLOBE, ARIZ.—The Arizona Commercial Mine Company is preparing to erect a \$50,000 power plant.

HOOD RIVER, ORE.—A Guignard et al are considering construction of a dam and hydroelectric plant to cost \$40,000.

BELLEVUE, IDAHO.—I. E. Rockwell, manager of the Rockwell-White Power Company of this city, has taken over the Bailey Electric Company.

OAKLAND, CAL.—The Great Western Power Company will construct a line from Fourth avenue sub-station to Yerba Buena station of the Key System. The estimated cost is \$100,000.

PORTLAND, ORE.—A franchise granting power and water privileges to the Oswego Lake Water, Light & Power Company has been approved by the board of county commissioners. The grant is for 25 years.

SPOKANE, WASH.—A hearing will be held by the commissioners of Spokane County on January 28th, on the application of the Valleyford Water Company for permission to construct electric transmission lines in the town of Valleyford.

TWIN FALLS, IDAHO.—All the property and holdings of the Great Shoshone & Twin Falls Waterpower Company have been sold at public auction for \$2,000,000 to F. F. John-

son of Boise, acting for the Electric Investment Company, with headquarters at Boise.

YREKA, CAL.—A. L. Harlow has completed arrangements for the purchase of the holdings of the Mount Shasta Land & Irrigation Company in the Big Springs section of the county. Mr. Harlow expects to install a new power plant and construct new ditches.

BOISE, IDAHO.—The state land board has directed State Engineer Smith to make an examination of the physical features regarding the completion of the works on the Twin Falls-Salmon River project so that the board may have the report when passing definitely on the application of G. M. Hall, manager for the project and O. O. Haga to have the work approved officially.

SALEM, ORE.—Permits for development of 952 horsepower from the John Day River and Warm Springs near Prairie City have been granted by State Engineer Lewis, to the Prairie Power Company. The company proposes to extend a canal near Prairie City about two miles, construct a reservoir at Strawberry Lake and develop power for lighting Prairie City, Canyon City and John Day. A large mining dredge will also be operated on Canyon Creek. The estimated cost of the project is \$45,000. A permit also has been granted to Horace G. Campbell of West Lake, Ore., to develop power at the outlet of Whoahink Lake in Lane county,

TRANSPORTATION.

UPLANDS, CAL.—Permission has been granted to the Pacific Electric Railway Company to construct a spur of track over and across Huntington Drive, near Orange Grove avenue.

RENO, NEV.—Reports come from Fallon, which are assuring that an electric road may be built there in the near future. R. W. Riley of Portland, has spent a couple of weeks looking over the project.

SAN DIEGO, CAL.—The street railway line to La Playa, the franchise for which was issued more than a year ago, will be built soon. It will connect with the Point Loma line where the latter turns off at Roseville.

PHOENIX, ARIZ.—It has been decided that the Phoenix Street Railway Company shall be given until October 1, 1917, to complete the work of double tracking its West Washington Street line. The tracks will also be doubled between Seventh and Seventeenth avenues.

LOS ANGELES, CAL.—The city council has adopted an ordinance consenting to the abandonment of a certain portion of a franchise heretofore granted to the Pacific Electric Railway Company to construct, and for a period of forty years to maintain a double track, or a four track elevated electric railroad, across certain public streets in this city.

SPOKANE, WASH.—Plans for a holding company to take over and operate both local street railway lines are nearing completion, according to reports from authentic sources. Such an arrangement, it is believed, will do much toward solving the financial loss confronting the Washington Water Power Company and the Spokane Traction Company in the operation of their street railways. Recently, before the city council, D. L. Huntington, president of the Washington Water Power Company, stated that the company's street railway business was being conducted at a loss and he expressed the opinion that the same was true of the operation of the Spokane Traction Company. Two factors have been making serious inroads into the business of the street railway companies. One is the increasing number of privately owned automobiles whose owners formerly patronized the street cars. Another is the jitney bus.

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SAN FRANCISCO, JANUARY 29, 1916

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P. P. I. E. AUXILIARY WATER SUPPLY.

BY E. C. EATON.

MODERN DIESEL ENGINES.

BY J. E. MEGSON AND H. S. JONES.

CLOSURE OF COLUMBIA RIVER CHANNEL.

BY L. F. HARZA.

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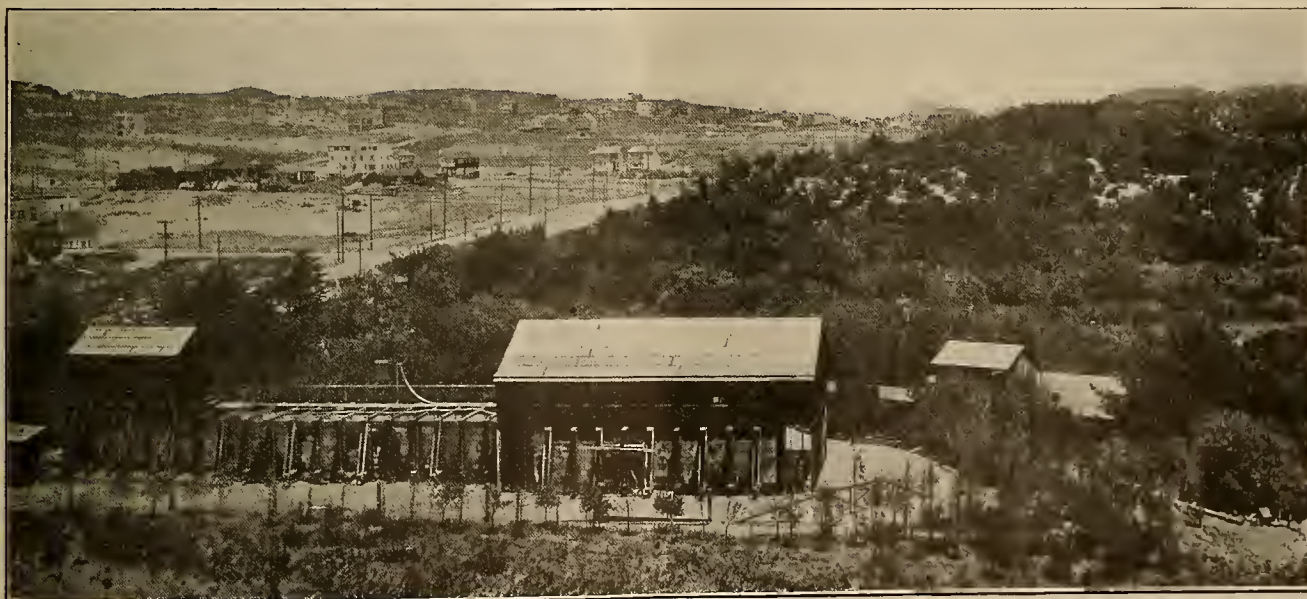
P. P. I. E. AUXILIARY WATER SUPPLY

BY E. C. EATON.

(This interesting account of developing, pumping and treating water from sandy soil contains several valuable suggestions for similar undertakings. It includes a description of an economical method of driving such wells and of water purification. The author was superintendent of the filtration plant described.—The Editor.)

The estimated water requirements for the Panama-Pacific International Exposition, including that for drinking purposes, watering lawns and filling fountains, was 1,500,000 gallons for an average day, and 2,100,000 gallons for a day of exceptionally large attendance. It was at first intended to obtain this supply from the Spring Valley Water Company by means of a tap at

from Lobos Creek, filtered, and pumped to a reservoir of 6,000,000 gallons capacity. The daily capacity of this plant is from 400,000 to 800,000 gallons in excess of the government's requirements, and arrangements were therefore made to purchase this excess for exposition purposes, and for the use of one-half of their reservoir, the excess water to be supplied to the exposi-



General View of Filtration Plant.

Van Ness avenue, which would have necessitated the expenditure of a large sum to increase the size of the water company's mains in this district. At a late date, after the distribution system had been installed in the grounds, the water company found that it could not bring into the city a sufficient quantity of water to supply both the increased needs of the city and the Exposition during the year 1915 and for this reason the exposition looked for an independent supply.

The federal government operates a filtration and pumping plant having a capacity of 2,000,000 gallons per day, which supplies the military reservation with drinking and irrigation water. This supply is taken

half by means of an overflow weir cut in the wall dividing the reservoir into two parts. This gave the exposition a reservoir of 3,000,000 gallons capacity, and a gravity pipe line was laid from this reservoir to the exposition grounds, a distance of 5000 ft.

To meet the excess water required, a source of supply of nominal capacity 1,500,000 per day was developed in the Richmond District about five miles from the exposition grounds, and known as "The Filtration Plant." This plant consists of: six deep wells and a sump from which water is pumped to a filtration and treating plant, and a main pumping plant supplying water to the Presidio reservoir.

Sources of Supply.

Owing to the nature of the soil in the Richmond district, which is a fine uniform beach sand having an effective size of 0.18 m/m and a uniformity co-efficient of 1.5 and to the reputed difficulties in eliminating sand from deep wells, it was at first decided to try a sump as a source of supply. A sump 200 ft. long by 14 ft. wide by 30 ft. deep was constructed of 4 in. timber piling and provided with 100 infiltration screens over openings cut in the timbers about 4 ft. above the bottom. The elevation of the ground surface at the sump is 7.5 city datum. On test only 165 g.p.m. or 240,000 g.p.d. is available from the sump as a continuous supply.

A test well was next sunk in the vicinity of Forty-seventh avenue and Fulton street, just outside of Golden Gate Park limits. In September, 1914, three 12-hour tests and one 24-hour test were made which indicated that 186 g.p.m. could safely be drawn from this well, with very little sand.

On the strength of this showing, four other wells were drilled in the vicinity on leased property. The wells are about 200 ft. apart and are all within a space of 650 feet square. The wells were all sunk until the clay stratum was encountered at depths ranging from 75 to 85 ft.

Owing to mutual interference it was estimated that with the five wells working simultaneously $2\frac{3}{4}$ times the safe delivery of one well could be counted upon. The decrease of course was due to mutual interference between the wells.

Filtration Plant.

Tests made from ground water in existing wells in this district showed a potable water but chemical and bacteriological analyses indicated that the water should be carefully watched and for this reason it was decided to build an up to date filtration plant. The plant is of the type known as the "rapid sand filter" and was designed by the writer, under the direction of G. L. Bayley, chief mechanical and electrical engineer for the exposition. The plans were later submitted to Professor Charles Gilman Hyde, consulting sanitary engineer, for his approval.

This type of filter employs a high rate of filtration through a special grade of sand, the rate in general use being not over 125,000,000 per acre sand surface per day as against 2,500,000 gallons as employed in the slow sand filter, the object of course being economy of space. The sand used had an effective size of .35 m/m and a uniformity coefficient of 1.5, and is somewhat finer than that in general use, as removal of bacteria was the main object.

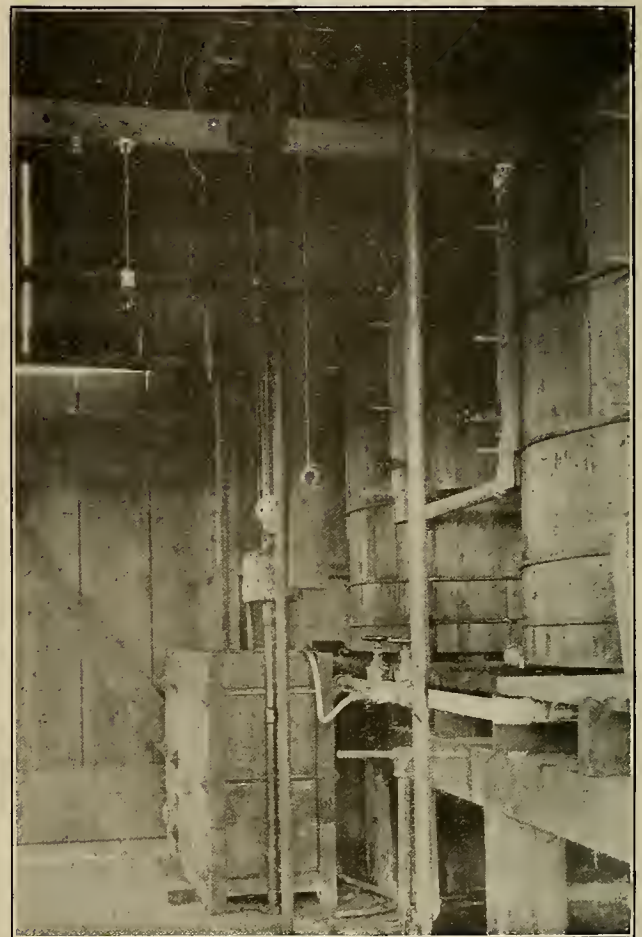
The filters are three in number, each having an area of 183 sq. ft. and a capacity of 500,000 g.p.d. each. The depth of the sand is 26 in., under which is about 18 in. of graded gravel over the strainer system.

The strainer system consists of a specially tapered header from which $2\frac{1}{2}$ in. lateral pipes, spaced 6 in. centers, lie horizontally on the bottom of the filter. These laterals have $\frac{5}{16}$ in. holes drilled on the under side, 3 in. centers.

Owing to the temporary nature of the plant a timber flume structure was used throughout.

The rapid sand filter depends for its efficiency of filtration upon a gelatinous blanket, or "floc," being artificially formed upon the surface of the sand by means of a coagulant such as aluminum sulphate, this floc preventing the passage of impurities through it. Due to the high rate of filtration, the sand requires washing every eight to twenty-four hours, for which special provision has to be made.

The method of washing used in this plant has been the use of a high velocity rate of washwater through the sand, the water combining the operations of stirring

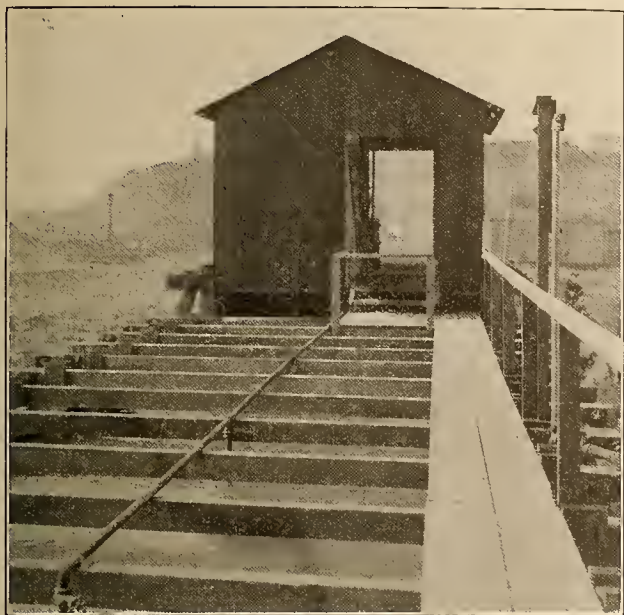


Automatic Coagulant Dosing Equipment.

and cleansing the sand. This has been entirely satisfactory and has resulted in less time taken in washing, and a saving in water required to wash.

Special attention has been given to the introduction of coagulant—aluminum sulphate. The floc, or aluminum hydrate is formed by a chemical action in which aluminum sulphate is decomposed by the calcium carbonates contained in the water, forming calcium sulphate which is soluble, and aluminum hydrate which is insoluble. From 20 to 30 minutes are required for the formation of this floc and it is important that this period be allowed, in order to form the required gelatinous blanket on the filters. It is also important that, during the formation, it shall not be broken up.

In the exposition plant the water is discharged from the sump and wells into a measuring chamber from which it flows through a submerged orifice into a raw water reservoir consisting of a flume 64 ft. 0 in. long by 12 ft. 6 in. wide by 7 ft. 0 in. deep, at the far



Coagulant Dosing Grids.

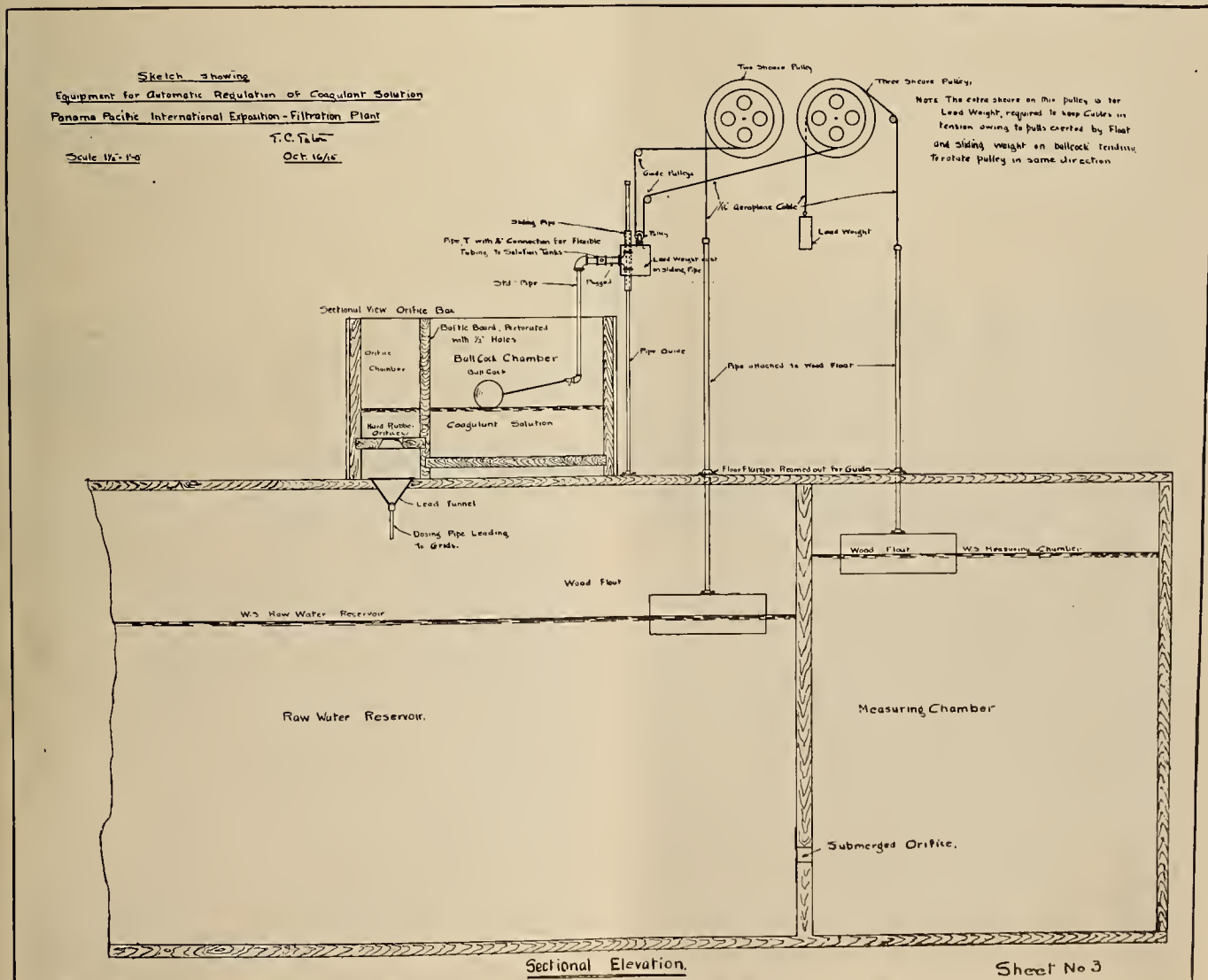
end of which the water is taken through the filters. The size and length of this flume is such that at the rated capacity of the plant 1,500,000 gallons per day, a

period of 40 minutes will elapse before the water entering the measuring chamber will reach the filters.

The aluminum sulphate solution is mixed in tanks in a house over the measuring chamber and fed to the water through a pipe grid consisting of a $\frac{3}{4}$ in. pipe having $\frac{1}{4}$ in. holes on the under surface. These grids are connected by $1\frac{1}{4}$ in. pipe to the solution tanks through an orifice box located near the solution tanks. Several grids are supplied at points in the flume, at various distances from the end discharging into the filters, so that one may be chosen that will give the required period of time for coagulation.

An automatic dosing equipment has also been installed which, to the best of the writer's knowledge, is new. A sketch of this is attached.

The raw water is discharged from the wells into a measuring chamber separated by a bulkhead from the raw water flume (or coagulating basin). The water flows from this measuring chamber into the coagulating basin through a submerged orifice, the quantity of water flowing being therefore in proportion to the difference in water levels in the measuring chamber and coagulating basin. As the water level may vary somewhat in the coagulating basin some mechanism was required that would keep a head over the dosing



Sketch of Automatic Dosing Equipment.

orifices in the orifice box proportional to the difference in the water levels between the measuring chamber and coagulating basin. This was accomplished by having two floats, one in each chamber, each terminating in a rod, to the end of which was attached a 1/16 in. diameter aeroplane cable. Each float actuated a cast iron wheel to which was fastened a piece of cable running through a pulley attached to a ballcock. The action was that the ballcock mechanism would respond only to differences in water level in the measuring and coagulating chambers thus maintaining a height of solution over the orifices in proportion to the amount of water flowing.

After filtering, the water is given a treatment of liquid chlorine at the rate of 3 lb. per 1,000,000 gallons of water. This equipment was installed by the Electro-Bleaching Gas Company of New York and has been entirely satisfactory, requiring little attendance and representing a big advance over the older chloride of lime treatment.

Experience With Operation of System.

Sump. A vertical 3 in. centrifugal pump was installed in the sump, discharging through a 6 in. casing pipe to the measuring chamber of the filtration plant.

The sump has been found capable of delivering 165 g.p.h. continuously with the water drawn down to the suction of the pump, elevation minus 18. The sump, when full, has a storage capacity of 500,000 gallons, and has been valuable as a regulating medium for the plant, supplementing the main reservoir capacity, as at times of small demand water would be allowed to accumulate, available for emergencies such as days of heavy demand.

The removable infiltration screens were cleaned in June and were found to be somewhat rusted and

gave evidence that cleaning every four months would increase the output of the sump possibly 10 per cent.

Deep wells. At an early date it was discovered that the results obtained from No. 1 well, the test well, were by no means indicative of what could be obtained from the other four wells. The only explanation of this is that a somewhat coarser material must have been encountered at No. 1 well than at the other locations.

To avoid the expense of taking out the deep well pump every time a well filled with sand, a small air lift was employed, consisting of a 1 1/4 in. discharge pipe and a 1/2 in. air pipe, this being the largest size pipe that could be inserted between the inside casing and the pump column. This proved to be satisfactory and would clean out a well in three hours, most of which time was taken up in preparing the equipment.

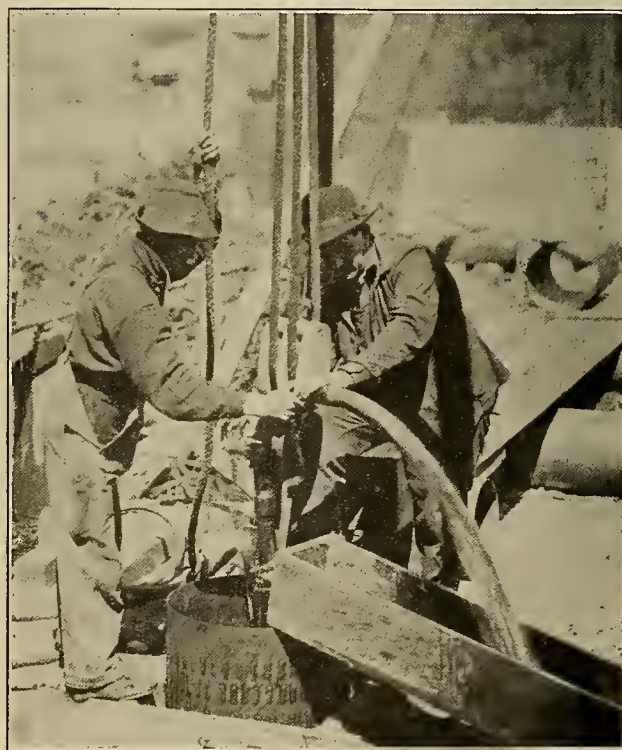
The pumps installed were vertical, 3-stage, deep well turbine pumps, 11 in. over all diameter, runners 8 in. diameter, rated at 250 g.p.m. under a total head of 75 ft. at a speed of 1500 r.p.m.

After nearly three months attempting to develop these wells it was decided to abandon them and experiments were made to determine a suitable perforation and a suitable filler between casings to eliminate the sand.

New type of well. First test plates were prepared, 8 in. by 12 in., each with different size perforations. Two of these were chosen and placed in a wood frame box with a trial mixture of sand and gravel between them. Above the topmost plate sand from the vicinity of the wells was placed, a cover put on the box, and water pressure applied. By taking readings of quantities of water and pressures, and an examination of the water discharged through the lower plate, the proper size perforation was decided upon and a sand filler chosen. This sand had an effective size of 0.42 m/m



Drilling Well No. 6—First Section.



Drilling Well No. 6, showing Water Jet Used.

and a uniformity coefficient of 2.18. It was accordingly decided to drill a new well using the sand filler and type of perforations thus obtained.

In order to allow for cleaning out the sand filler between the casings if it should become clogged up, a 3 in. space between the casings was allowed, thus making the inside casing 16 in. and the outer 22 in., instead of 16 in. and 20 in. employed in the first wells. The writer drilled this well in three days by using a simple hydraulic jet, instead of the regular well-drilling rig, at a cost of \$3.89 per foot depth. As the contract price for the old type of well was \$7.50 per foot and the difference in price of 20 in. and 22 in. casing is 10c per foot, probably the best price that could be obtained for a new well of this type would have been \$7.60 per foot, thus representing a saving of nearly half of the contractor's price. This well is 60 ft. deep and on a 20 hour test gave the following results:

Discharge G.P.M.	Drawdown Feet.	G.P.M. per ft. Drawdown.
5	1.5	3.3
20	3.25	6.15
35	4.33	8.10
60	5.91	10.15
110	8.43	10.50
125	11.90	10.50
155	13.40	11.56
175	15.00	11.62
200	16.40	12.20

No sand whatever was noticeable in the discharged water.

A pump of the same type as those installed in the other wells was installed in this well and has been running continuously since May 28, 1915, when the well was drilled, with no trouble whatever. The success of this well resulted in a determination to overhaul wells Nos. 2, 3, 4 and 5 in a similar manner. As it was impossible to withdraw the old inner casing a new casing, 13½ in. diameter, was placed inside the well, leaving a 1 in. space between it and the old inner casing. This was filled with the same grade of sand as in the new well, and has been satisfactory, although not as good as for No. 6 well, owing to the thinness of the gravel layer, which is 1 in. instead of 3 in. A test of one of these reconstructed wells (No. 4) gave the following results:

Discharge G.P.M.	Drawdown Feet.	G.P.M. per ft. Drawdown.
10	3.75	2.67
49	6.92	7.07
92	12.08	7.62
140	17.33	8.07
202	23.83	8.45
243	27.60	8.80

City Installation.

In August, 1915, anticipating the possible heavy demands of September, permission was obtained from the City of San Francisco to use two wells in the vicinity of the plant, recently drilled by the city but not yet in use. These wells had purposely been driven 210 and 303 ft. deep to tap the lower water stratas. to obtain a purer water.

An analysis of water from these wells showed a low count so that it was not considered necessary to filter this water, but as a precautionary measure, a treatment of chlorine at the rate of 3 lb. per one million gallons was given. As the installation was an auxiliary one only, an air lift, made up of standard 4½ in. pipe with 1½ in. air pipe was installed in each of these wells, with 2½ in. air piping running from an 8 in. by

10 in. compressor 1700 ft. distant. The water is discharged into weir boxes, from which it flows by gravity through a 6 in. wire-wound wood pipe to the filtered water reservoir into which it discharges and receives a chlorine treatment before being pumped to the exposition.

With both wells running at the same time and a submergence of 67 per cent and 57 per cent respectively, 138 g.p.m. and 115 g.p.m. were discharged at 241 r.p.m. compressor speed.

With one well alone (No. 617) and 54 per cent submergence, 172 g.p.m. was discharged, and with No. 628 running alone, 220 g.p.m. were discharged with 61 per cent submergence at the same compressor speed.

A certain amount of fine sand was discharged for about five to ten minutes after first starting the pumps, after a shutdown, and on one occasion two yards were thrown by one of the wells in four hours. In all, the wells have been in use 660 hours, and have pumped 10,000,000 gallons of water, during which time a total of about five cubic yards has collected in the weir box.

Operation of Filtration Plant.

No serious trouble has been experienced with the filtration plant. At exactly the rating of the plant, 1,500,000 gallons per day, the filters operate automatically by means of the automatic controller, as shown on drawing.

Table No. 2.
Actual Quantities Pumped, and Cost of Water.

Month (1915).	Gals. from Expo- sition Wells.	Gals. from Expo- sition sump.	Gals. from City Wells Nos. 617 and 628.	Total Gallons.	Average g.p.m. per deepwell pump.	Cost—Cents per 1000 Gals.
March ...	9,889,710	233,100	.....	10,122,810	98	.....
April	14,193,360	3,559,440	.....	17,752,800	130	.....
May .....14,335,520	3,168,180	.....	.....	17,503,700	122	11.35
June .....28,298,500	3,433,500	.....	.....	31,732,400	157	5.65
July .....30,820,400	2,042,500	.....	.....	32,862,900	142	7.42
Aug. ....31,174,000	3,505,600	1,085,300	.....	35,764,900	129	6.37
Sept. ....24,795,050	2,867,200	3,920,350	.....	31,582,600	131	6.95
Oct. ....18,181,030	2,167,720	1,168,850	.....	21,517,600	132	8.47
Nov. ....4,547,230	4,108,600	3,856,670	.....	12,512,500	101	8.75

Note:—Costs of water include power, oil, sulphate, operators, superintendence and repairs to pumps, but do not include any interest or depreciation on investment.

Costs of water. Table No. 2 gives actual quantities of water handled by the filtration plant together with the average gallons per minute per well and the cost in cents per 1000 gallons. The power rate was 0.6 cents per kw.-hr. plus a monthly maximum demand charge of \$2 per kw. maximum half hour demand.

Due to the fact that the reservoir capacity is small the plant was called upon for varying quantities of water daily and the best advantage could not be taken of this method of charging. The rate has been equivalent to a charge of 1¼ cents per kw.-hr. without maximum demand. The costs of water include power, oil, sulphate, operators and superintendence, and repairs to deep well pumps but does not include any interest or depreciation on the plant. The greatest item of cost has been the power required to pump to the reservoir a static head of 365 ft. through 19,300 ft. of 12 in. pipe line. The itemized costs for the month of June are as follows:

Cost of Pumping from Deep Wells, per 1000 Gals.

	Cents
Power	0.956
Operators and superintendence.....	0.607
Repairs to pumps.....	0.047
Oil, grease, waste, etc.....	0.017
	1.627

Cost of Filtering and Treating Water, per 1000 Gals.

	Cents
Sulphate of Alumina.....	0.250
Chlorine	0.056
Washwater	0.045
Operators and superintendence	0.623
	0.974

Cost of Pumping to Main Reservoir, per 1000 Gals.

	Cents
Power	3.410
Operators and superintendence.....	0.631
Oil, waste and miscellaneous.....	0.004
	4.045

Total—6.646 per 1000 gals.

Costs of plant. The filtration plant, including all structures and connecting piping, also the pump houses and foundations for pumps and motors at the deep wells and sump, was installed under contract, the price being \$14,575. This did not include sand and gravel, but included the placing of same. The filter sand, 0.35 m/m effective size, came from the bay shore about 60 miles south of San Francisco, and cost \$2.75 per yd. delivered at the plant in carload lots. The graded gravel cost \$2.50 per yd. delivered.

Wells. The first five wells were drilled under contract for \$7.50 per foot. The sixth well, drilled by the hydraulic process, cost \$3.89 per foot. The itemized costs of this well are as follows:

Double casing, 12 gauge	\$2.65
Gravel blanket .....	.09
Cement plug .....	.01
Labor	1.14
Total per foot	\$3.89

Pumps. The three main pumps, which are 5-stage, 6 in. turbine pumps, speed 1600 r.p.m., 500 g.p.m. each at 220 lb. pressure, cost \$600 each, with no erection. The three inch vertical centrifugal pump, 1250 r.p.m., 250 g.p.m., 85 ft. head, cost \$195 erected. The five 11 in. deep well pumps, 70 ft. long each, rated at 250 g.p.m. under 75 ft. lift, speed 1500 r.p.m., cost \$547 each in place. The 10 in. horizontal centrifugal pump, 2800 g.p.m., at 35 ft. head, 525 r.p.m., cost \$233 not erected.

Efficiencies of Pumping Equipment.

Tests were made on the main pumps, deep well turbine pumps, vertical centrifugal pumps and air lift after they had been in service eight months. The tests were made with a test gauge and weir box, the power being measured with a stop watch on the integrating meter.

Main Pump.—Rating. 6 in., 5-stage, horizontal turbine pump, 500 g.p.m. at 220 lb. per sq. in. pressure, 1600 r.p.m. belted to 125 h.p. induction motor:

Motor efficiency assumed.....	85 per cent
Belt efficiency assumed.....	92 per cent
Test: Head = 367.7 ft.	
Q = 642 g.p.m.	
Theoretical power required =	59.5 h.p.
Actual motor input =	157.5 h.p.
Pump efficiency	48.6 per cent
Wire to water efficiency..	37.8 per cent

Deep well pump.—Rating. 11 in., 3-stage, vertical turbine pump, 250 g.p.m., 75 ft. head, 1500 r.p.m., belted to 15 h.p. induction motor.

Motor efficiency assumed.....	85 per cent
Belt efficiency assumed.....	88 per cent (quarter turn.)
Test: Head = 55 ft.	
Speed = 1175 r.p.m.	
Q = 192 g.p.m.	
Theoretical power required =	2.67 h.p.
Actual motor input =	12.65 h.p.
Pump efficiency	28.2 per cent
Wire to water efficiency..	21.1 per cent

Sump pump.—Rating. 3 in., single-stage, vertical centrifugal pump, 250 g.p.m., 85 ft. head, 1250 r.p.m., belted to 20 h.p. induction motor.

Motor efficiency assumed..	85 per cent
Belt efficiency assumed....	88 per cent
Test: Head = 85.25 ft.	
Speed = 1155 r.p.m.	
Q = 192 g.p.m.	

Theoretical power required =	4.15 h.p.
Actual motor input =	12.65 h.p.
Pump efficiency	37 per cent
Wire to water efficiency....	28 per cent

Air Lift in City Well No. 628.—Rating. 4½ in. air lift with 1½ in. air pipe. Air pipe passed through center of discharge pipe.

Air compressor 8 in. by 10 in., Sullivan, belted to 35 h.p. induction motor. Receiver at compressor. Air line 1700 ft.; 2½ in. W.I. pipe to wells.

Test. Compressor speed = 241 r.p.m.

Q = 220 g.p.m.

Submergence = 61 per cent.

Compressor displacement, cu. ft. air per gal of water = 0.637.

Pump efficiency 24 per cent |

Wire to water efficiency... 18 per cent

Note:—Compressor overspeeded 60 per cent above rating. Efficiency includes losses in 1700 ft. of air pipe.

Interference Between Wells.

The interference is expressed as the percentage reduction in yield per well below that of a single well uninfluenced by others.

The wells are located approximately 200 ft. apart.

After No. 1 well was drilled and before drilling the other wells the assumption was made that 186 g.p.m. was a safe delivery from each well and that with all five wells running at the same time, 2¾ times the yield of one well, or 102 g.p.m. per well, could be counted on, giving an interference of 45 per cent. The results obtained are somewhat better than this. The averages for the month, together with the average gallons per minute per foot drawdown in the water surface are as follows:

Month	Average G.P.M. per well.	Average G.P.M. per ft. drawdown.
1915.		
March	98	7.85
April	130	14.80
May	122	12.36
June	157	13.30
July	142	8.04
August	129	6.35
September	131	6.60
October	132	6.70
November	101	5.47
Average	127	9.03

The average for the nine months is 172 g.p.m. per well with a drawdown of 9.03 per foot, or 14.1 ft.

Referring to the test of No. 1 well, for a drawdown of 14 ft. we should expect 230 g.p.m., giving an interference of about 45 per cent. This result is not correct, as No. 1 well alone would not give as good a delivery throughout the season as that shown by the test of September, 1914, but will give the results to be expected from a group of wells in actual operation, continuously, as compared with a single well tested under the best conditions.

During the month of November, when the plant was running only 16 hours a day, measurements were taken to determine the effect of operating the exposition wells on the water levels on wells in the vicinity. The water levels were measured after all wells had been shut down for eight hours, and again after wells were in operation for eight hours. The average of all the measurements is as follows:

	Feet
Exposition Wells Nos. 3 and 5, water drawn down 17 ft.—drop in Sutro Well	0.52
Exposition Well No. 3, drawn down 19 ft.—drop in Sutro Well	0.15
City Well No. 617, drawn down 42 ft.—drop in City Well No. 628	3.90
City Wells Nos. 617 and 628, drawn down 35 ft. and 41 ft. respectively—drop in City Well No. 616.....	0.18

Estimate of Quantity of Water Available in Richmond District.

From the observations made during the operating period an estimate may be made of the quantity of water available in this district. The test borings made, together with the depths of the six deep wells which were put down, indicate that the clay strata rises towards the surface as we go in a southerly direction and may indicate the presence of a divide in the underground waters about midway through the park. This would also account for the small amount of water, relative to its size, obtainable from the sump and would also account for the fact that the water flows into the sump in greater quantities at the north end than at the south end. The results show that during the months of heavy pumpage, July, August and September, more water was withdrawn than the daily flow. The figures indicate that with the present arrangement of these wells about 700,000 gallons per day can safely be drawn from the area affected by the wells. The area tributary to these wells is probably $1\frac{1}{2}$ square miles, giving a safe yield for this district of 465,000 gallons per day per square mile, or $9\frac{3}{4}$ in. annually over the area.

Conclusions.

The average daily rate of pumping 640,000 g.p.d., has been close to the average daily quantity flowing past the area affected, 710,000 g.p.d., and is equivalent to less than 10 in. rainfall over the area if this rate were continued through the year, agreeing closely with the value obtained for Lobos Creek area, of 10.7 in.

A type of well having the size perforation and gravel filler best suited to the particular district, as chosen by test, can be drilled at a cost under \$4 per ft. up to 100 ft. depth, and will entirely eliminate the sand from the well. A 3 in. space should be allowed of this material.

A single well of this type will safely discharge, continuously, over 200 g.p.m. with a drawdown of less than 17 ft. in the water surface, or, a group of wells, spaced 200 ft. apart, can be counted on for over 155 g.p.m. with the same drawdown.

The design, construction and operation of the system was carried out, under the direction of G. L. Bayley, chief mechanical and electrical engineer, P. P. I. E., by the writer



Interior of Well-Lighted Store.

EFFECTIVE LIGHTING OF A RETAIL STORE.

"Trade follows light" is a slogan which is well exemplified in practice in the case of a retail haberdashery store on Market street, San Francisco, where the installation of proper illumination was followed by a fifty per cent increase in business. The accompanying pictures of Hansen & Elrick's store tell their own story of the effectiveness of light, properly placed, in aiding the sale of goods.

The ample lighting of the entrance is such as to attract favorable attention from the pedestrian. This is secured by means of a 1000 watt type C Mazda lamp in a Holophane Realite suspended from the arched entrance way and a 60 watt lamp with flange and bowl reflector over the door, together with 44 lamps placed in the double-story window display. These latter are 100 watt type C units in Holophane prismatic window reflectors.

The firm name appears in an arched sign over the entrance. The 15 in. letters are of opal glass with metal background, the letters being illuminated by twenty-five 40 watt lamps in Holophane metal reflectors placed 30 in. back of the sign.

Further interest is induced by the brilliant lighting of the interior which brings out the attractive features of the stock displayed. General illumination is obtained from two 300 watt type C lamps in Realite reflectors and thirteen 100 watt units strategically placed on the ceiling in Holophane prismatic reflectors. What would otherwise be waste wall space is utilized by nine display cases near the ceiling, each fitted with three clear prismatic reflectors carrying 40 watt lamps.

The bookkeeping department and stock rooms on the second floor are well lighted by means of twelve 60 watt lamps in prismatic reflectors on the ceiling.

This installation typifies how the lighting expert can assist in making the retail store attractive to the shopper. Good lighting helps sales, as it not only calls attention to goods that might otherwise be overlooked, but it also satisfies the consumer as to the quality of the articles purchased.



Illuminated Store Exterior.

DIESEL ENGINE PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

Modern Engines.

(Continued.)

The Allis-Chalmers Manufacturing Company of Milwaukee are manufacturing a horizontal oil engine, shown in Fig. 18. This engine is designed under the Lietzenmayer patents, using the open type of fuel nozzle of that name. In this type of nozzle, shown in Fig. 19, the fuel is delivered by the pump into a

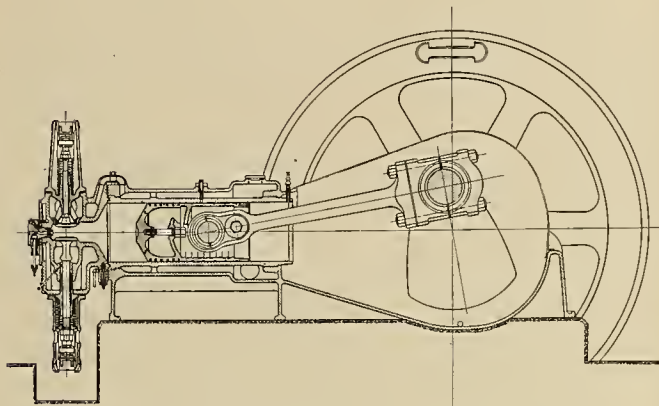


Fig. 18. Section of Allis-Chalmers Engine.

passage which through a nozzle is at all times in open communication with the cylinder. The compressed injection air is closed off from the passage by the injection valve. When this valve is lifted from its seat the stream of air scours over the surface of the accumulated fuel and atomizes it with an action similar to that of a file upon a metal surface. The final atomizing and spreading is performed in the passage through the nozzle as in the case of the Diesel atomizer. The multi-stage air compressor is mounted on the side of the

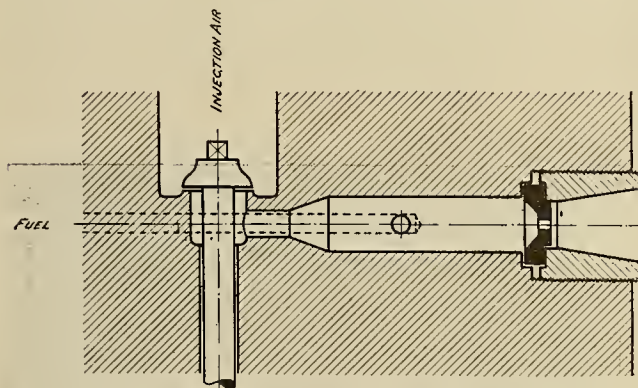


Fig. 19. Lietzenmayer Fuel Nozzle.

frame and actuated from the crank shaft. Air is delivered directly to the fuel nozzle without the use of the usual storage tank. The regulation is performed by varying the effective stroke of the fuel pump plunger under governor control. A gravity oiling system with filtering arrangement and pump is used for all important bearings. The lubrication of the cylinders, and in special cases that of the exhaust valve stems is performed by a forced feed oil pump. The size of the 115 h.p. cylinder operating at 200 r.p.m. is 18 in. in diameter, 27 in. stroke. The weight of a 230 h.p. engine of two cylinders of the above size is 160,000 lb., including a 17,000 lb. fly wheel.

The Snow oil engine built by the Snow Steam Pump Works of Buffalo, N. Y., (Fig. 20) is a four-stroke-cycle engine, although this company manufactures engines both of the two-stroke-cycle and four-stroke-cycle. These engines are provided with cross-heads. An air compressor is mounted on a pad on the side of frame and is driven by a drag crank on the end of the shaft. The cylinder head, particularly in the two-cycle type, is, of course, free from valves and naturally simple in its construction. The lubrication

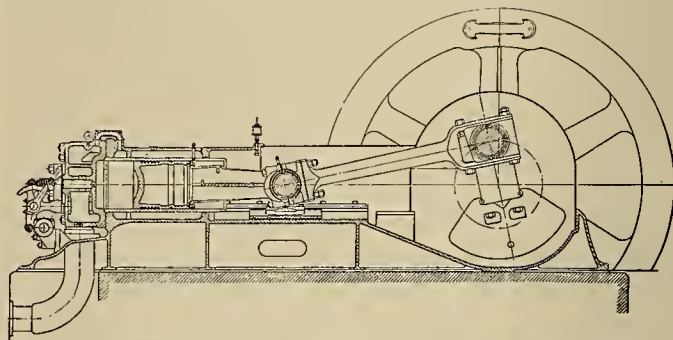


Fig. 20. Sectional View of Snow Engine.

of the cylinder is effected by a Richardson positive force feed pump. These engines employ a modified type of open nozzle and the regulation is accomplished by varying the stroke of the fuel pump plunger by means of a sliding wedge operated by the governor. The piston head in many of the engines manufactured by this company is removable, being bolted on to the piston proper. In this way the portion of the piston which is subject to the greatest heat is easily removable and renewable.

The Dow Willans Diesel type oil engine is built by the Dow Pump and Diesel Engine Company, Ala-

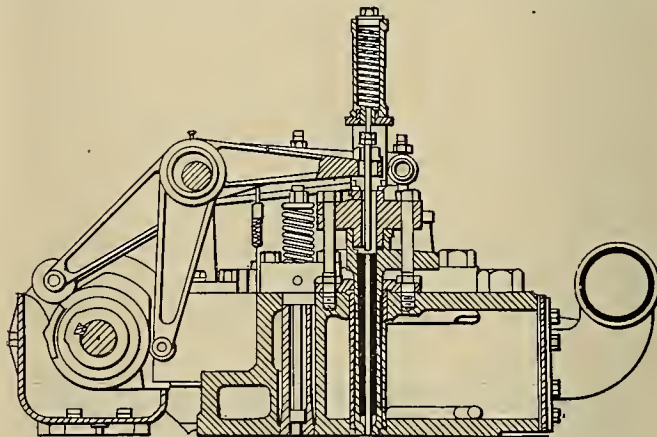


Fig. 21. Section of Willans-Robinson Cylinder Head.

meda, California, under the license of Willans-Robinson of Rugby, England. It naturally follows very closely the design of the engine built in England, which is of the "A" frame type with centrifugal oilers on the crank pins and mechanical lubrication of the pistons pin, the lubrication of the cylinders also being under control of a mechanically operated lubricating pump. The main bearings are ring oiled. This engine is built in 50 h.p. per cylinder, any number of units being combined to make engines of from 150 to 450 h.p. The cam shaft is open type, the valves in the head of the engine being contained in cages shown in section of Fig. 21.) The compressed air for both starting and

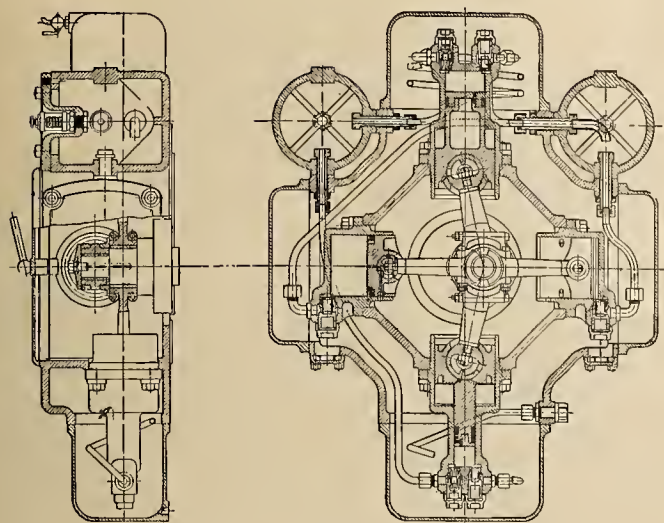


Fig. 22. Willans Compressor.

atomizing is delivered by a Reavell air compressor directly coupled in the end of the crank shaft. This air compressor is of a type built in England and has the four cylinders set two vertically and two horizontally opposite each other. It is of the three-stage type with two cylinders for the first stage. A cut of this compressor is shown in Fig. 22.

The Harris valveless engine, built by the Southwalk Foundry & Machinery Company of Philadelphia, Pa., under the Harris patents, is of the vertical two-stroke-cycle type. Stepped pistons perform the double function of scavenging pumps and low pressure stages of the air compressor, the intermediate and high pressure stages of which are arranged in line with the working cylinders.

The Nordberg Manufacturing Company of Milwaukee, Wis., are to manufacture a Diesel engine under license from Carels Brothers of Belgium. There are at present installed in New Mexico two engines manufactured in Belgium. These are of 1250 b.h.p. in five cylinders and are direct connected to electric generators. These are the largest Diesel engines at present in operation in this country and the report of the purchaser is entirely satisfactory. The Nordberg Company is at present manufacturing a duplicate of the two engines installed under the Carels' license.

Air Compressor.

A typical type of air compressor, see Fig. 22, is of the three-stage type, pyramid piston, capable of compressing to 1200 lb. per sq. in. This compressor is often integral with the engine and driven directly from the main shaft. To avoid lubricating difficulties and the danger of explosion of lubricating oil gases as well as to reduce the dimensions and power consumed in the compressor, it is thoroughly water cooled, being provided with ample inter- and after-coolers. The compressor is provided with automatic valves of very limited lift, closed by springs, the valves being set in cages which can be readily removed for regrinding, and the compressor delivers absolutely cold air at 1000 lb. pressure.

Another type of compressor is a two-stage directly coupled to the engine, the compressor, of course, being thoroughly water-cooled and will deliver air at from

1000 to 1200 lb. per sq. in. All the Diesel engines made in America at the present time supply some type of directly driven compressor. Some manufacturers are directly connecting a separate air compressor by means of a coupling.

The bearings in the vertical Diesel engines are rigid, with ample surface provided for sufficient lubrication so that the wear on them is negligible. The advantage of this rigid construction is obvious in the case of multi-cylinder engines in which there are a number of bearings in line; it is difficult to adjust such bearings without removing the shaft. The lower shells of the rigid bearings are made in a complete circle so that they can be turned out in case of accident by taking off the cap and turning the engine over, bringing the shell on top of the shaft and this can be accomplished without lifting the shaft. The bearing could be then rebabbitted, the bearings scraped in with the mandrel made the size of the shaft and replaced the same way it was turned out. It is necessary in this type of bearing to scrape the cast iron in which the bearing shell rests to a perfect fit to the shell, which requires great care and patience.

The shaft in four-stroke-cycle engines are practically alike; the cranks are set at 180 degrees, the two centers against the two ends; the firing of the cylinders is usually No. 1, 2, 4, 3, No. 1 being toward the fly wheel. The shafts are usually an American product, although some companies were depending on shafts shipped from abroad. The extension shaft of some engines is provided with one outboard bearing, the coupling being inside the crank case. Other engines are provided with two outer bearings, one each side of the generator with a coupling between the inside bearing and engine. The former, with the one outboard bearing, however, has a bearing of extra dimension inside the engine to support the additional weight of the extension shaft, fly wheel and generator, in the case of direct connected electrical equipment. With this arrangement there is less floor room occupied but the two outer bearings prevent a strain on the rigid coupling between the extension shaft and the crank shaft. The fly wheel on the Busch-Sulzer engine is split on the arms, which gives additional strength against bursting over a fly wheel split between the arms, which is, however, the usual practice and the one followed by many manufacturers with good success. The weight of the fly wheel is varied to suit the service performed by the engine, the heaviest fly wheel being provided with engines driving alternating current generators. It is often the case where an engine is belted to design a flywheel that will also be a band wheel and in this way the space occupied is greatly reduced and the expense also lessened.

All Diesel engines are provided with a thorough water cooling system, taking care of the parts of engine which need cooling, such as the cylinders, heads, exhaust valve stems, air compressor and in some cases the exhaust piping. Salt water can be readily used for this purpose; the average cooling water consumption is approximately four to six gallons per horsepower hour.

[To be continued.]

REPORT ON THE COLUMBIA RIVER POWER PROJECT.

BY L. F. HARZA.

Appendix E—Available Power.

Present physical conditions to be met at the dam-site. By reference to Fig. 10 (See p. 447, *Journal of Electricity*, Dec. 11, 1915), it will be seen that the channel at the proposed damsite has a width of about 150 ft. and a depth at low water of about 100 ft. The channel widens and deepens as it progresses until it reaches the large pool about 250 ft. downstream from the neck where the average depth at low water is about 140 ft.

The usual rise at the damsite during the June flood is about 70 ft., and the maximum rise (1894) about 93 ft. Although the annual rise is great, a study of the hydrographs (Figs. 14, 15, 16 and 17, pp. 463-464, *Journal of Electricity*, Dec. 18, 1915), will show that the river is remarkably free from sudden out-of-season floods so common in most rivers. This uniformity of flow is due to the immense size of the drainage area such that changes in meteorological conditions seldom affect the entire area at the same time, and to the widely diversified climatic conditions obtaining on the watersheds of the individual tributaries, because of which even important individual irregularities become averaged into a smooth curve in the main river. It is believed that the working season can be closely predicted and work planned with reasonable assurances to conform to the regimen of the stream. It will be noted that the low water season extends from about the first of September to the first of April, or about seven months in all, including the winter season, and that this duration is very regular.

The ice phenomena at the damsite are quite variable. Often no ice forms on the river at this place. Occasionally a few days of severe weather cause ice to form here and above, usually lasting but a few days and then going out with a slightly rising stage. In appendix B is given a list of such ice notes as are available in the records of the U. S. Weather Bureau. The many contracted channels such as those at Hellgate, (between Miller's Island and the Washington shore, see Fig. 1), Ten Mile Rapids, Five Mile Rapids and other places are said at times, although only at rare intervals, to cause immense ice jams. In 1909 such a jam existed at Hellgate, at Ten Mile Rapids and also at the damsite, and backed the water up at each place until a considerable head was created. It is said that at the damsite under consideration it so blocked the channel as to cause the water to overflow the rock bench to the right, to accomplish which a rise of 40 to 50 ft. would have been required.

This phenomenon at Ten Mile Rapids and Celilo has been described by W. G. Carroll, U. S. Assistant Engineer, as follows:

* * "The writer resided at Celilo during the winters of 1907-1908 and 1908-9, being in local charge of the construction of The Dalles-Celilo Canal.

"In this period no unusual ice conditions prevailed except during the latter named winter, when more than ordinarily low temperature occurred, extending over a considerable time.

"Ice 12 inches in thickness was harvested above Celilo Falls by Mr. Taffe, and stored in the icehouse at Celilo.

"Upon the breaking up of the icebound river, a jam formed in the vicinity of The Dalles" (believed to be at the damsite) "and in a very short time, the stream above became obstructed by the accumulated drifting ice, the obstruction extending upstream as far as the head of Celilo Falls.

"No open water could be seen between The Dalles and Celilo, and this condition remained for a week or more; above Celilo the river remained open to Hellgate, where another jam was formed, but I had no close range view of conditions at the latter locality.

"Just below the main falls at Celilo, the river rose to within two feet of the top of the riprapped fill on the river side of the boat basin wall." * * * "At the head of Ten Mile Rapids, the river rose to within about ten feet of the top of the canal embankment on the river side of canal," (or to elevation 130, which is 58 ft. above normal elevation for the flow recorded at that time, 65,000 second feet.)

"I am unable to give you the heights at Five Mile Rapids or Big Eddy, as they were observed from the railway train only, this portion of the canal not being under construction at the time."

At minimum stage the average velocity in the river cross section at the damsite is about 7 ft. per second and during a flood stage it is probably about 20 to 25 ft. per second in the main channel.

Usual type of construction. From the conditions recited above it is evident that no ordinary methods of dam construction are applicable here unless at great hazard. Although the depth of water upstream from the neck is comparatively small, yet the depth downstream is great and any cofferdam and concrete work would need to pass through at least one flood. These facts combined with the great range in elevation and volume to be handled argue against any attempt to unwater the site or even to divert the river by means of cribs through a special channel.

Rockfill dam. A rockfill dam to be built without unwatering the river bed appears at first glance to be the only practicable plan. The conditions to be met and the magnitude of the undertaking are however entirely unprecedented even for that type of dam. While the present velocity at low water (7 to 10 ft.) would probably not be sufficient to move large rocks, and while this velocity would be still further reduced by the construction of a bypass or diversion channel of equal cross-sectional area to that of the river channel, it is to be remembered that the introduction of any structure into the channel will create conditions like those of a submerged weir. The local head and corresponding velocities will progressively increase as the structure rises until the latter reaches a point where it will probably remove even the largest and heaviest rocks from the excavation. Furthermore the material deposited in the fill naturally becomes more unstable as the fill rises in height, and is more readily eroded from the lower side of the mass. It may therefore be accepted as fundamental that no rockfill structure made with loose rock from the excavation in the ordinary gradual manner is practicable, and that special means must be provided to insure the rockfill from removal by the current during the stage of construction when the water is flowing over it, if indeed such overflow is to be permitted at all.

Several methods of overcoming these difficulties and of constructing a rockfill dam at this site have been suggested, each of which follows one of the following basic principles:

- (1) The deposition of fill material more rapidly than it can be carried away by the current;
- (2) The construction of some form of screen or other obstruction to prevent the current from carrying away the fill material so that the work of filling can proceed as slowly as desired;
- (3) The use of fill material of such size, shape or make-up as not to be moved by the current.

There has been designed a diversion channel for all types of dams herein considered, whether loose fill or concrete, with bottom elevation 40 and net width

against overflow by an ordinary flood would require completion to at least elevation 130 with 2 on 1 slopes and 50 ft. top width (section not shown in sketch) in eight months, a total of about 550,000 yd., or the placing of about 2300 yd. per day.

Rockfill dam—Plan A. The scheme designated as "A", Fig. 30, is an application of the basic principle No. (1) as previously expressed. It provides for the concentration on the river bank of a large amount of the average material derived from the excavation of the flood channel and bypass, in such a way that it can be precipitated suddenly into the river gorge which it will fill to such elevation as necessary to force the river wholly through the bypass channel prepared in readiness. This would be done at the beginning of a low water season and would permit

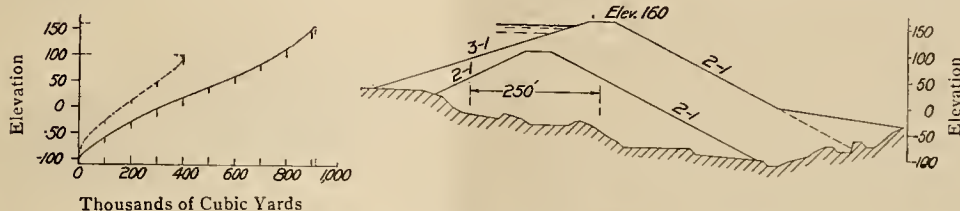


Fig. 29. Outline of Initial Diversion Dam and Final Loose Fill Dam with Curves of Required Material.

of 350 ft. requiring a velocity of about 10 ft. per second for passing 100,000 second feet, when the elevation of water surface is 70 ft. or essentially equal to that required under natural conditions for the same discharge.

In Fig. 29 are shown cross-sections for two dams, one 50 ft. wide, top elevation 100, with slopes of 2 on 1, and the other 50 ft. wide, top elevation 160, with upstream slope of 3 on 1 and downstream slope of 2 on 1. The former is intended as a diversion dam high enough to divert for an 8 months' season of low water. It is the first stage of construction of the latter, which is the completed structure. To conform to the usually accepted practice, the diversion dam (which would consist of very coarse material to prevent movement by the current) would be built at the location and become a part of the downstream toe of the ultimate dam, instead of in the location indicated by Fig. 29. The local conditions however are not favorable to this plan. The damsite topography (see Fig. 10) shows that the upper neck of the gorge is narrow and shallow, thence widening and simultaneously deepening immediately below to form the great pool. The much more expensive character of the materials constituting the diversion dam as compared to those for the remainder of the fill, and the desire that diversion be accomplished as rapidly as possible, dictate that the diversion dam be built as far upstream in the shallower and narrower channel as possible and yet leave space for a sufficient thickness of finer materials on the upstream face to gain a reasonable degree of water tightness.

At the left of the cross-sections are shown curves of accumulative quantities of all embankment material for both sections. The completed dam would thus require about 920,000 cu. yd. and the diversion dam about 400,000 cu. yd.

To construct from the beginning a dam safe

the dam to be completed during the remainder of that season.

Fig. 30-A indicates an uncoursed rubble retaining wall on each side of the river at the damsite, this wall to be built with rock from the adjacent excavation, using lean cement mortar made from the sand in the sand-bars just above. Behind this wall loose rock would be piled just as it comes from the excavation. At the beginning of a low water period, probably about September 1st, this wall would be destroyed by charging and firing the holes previously drilled, and which are shown by dotted lines in the sketch, by which blast the retaining wall and the rock foundation would be broken along a slope of about 45 degrees. To furnish access to the blast holes for loading, two alternative methods are shown on the two sides of the river. In one, the rear portion of the retaining wall and the loose fill would be built on concrete arches such as shown to the right of the sketch. These arches would furnish access for loading and would be destroyed with the same blast in order that the falling of the superimposed rock might add momentum to the mass.

The other method of loading would be through the tunnel shown in the wall on the left bank. This method would eliminate the concrete arches.

There might also be provided, in the loose rock above the arches, a steel sheet diaphragm on the slope of rupture in order to eliminate any question as to the certain sliding of the material. This diaphragm might also permit the use of a flatter angle than 45 degrees in this portion.

The section of these rock piles shown in the sketch would provide, above the natural rock surface and above the 45 degree line, a combined quantity of 1600 yd. per foot of length, requiring 250 ft. length of pile for the required fill of 400,000 yd. This would concentrate the rock slide in this short distance to min-

imize the tendency of the mass to disintegrate around its surface while displacing the water, and to secure as great a height of crest as possible with a given quantity of rock should it be found that the rock came to rest at a flatter slope than 2 on 1. In reality a longer pile than 250 ft. with correspondingly increased yardage is contemplated, the extra length to be on the downstream side to help fill the deep pool, thereby to reinforce the lower toe and insure as steep a slope as possible when the mass comes to rest. The total yardage precipitated into the river at one time would be about 550,000 yd. with a pile 350 ft. long.

It is proposed that this rock slide shall immediately accomplish the diversion of the river through the by-pass and thus avoid the overtopping of the fill during construction. The dam would next be completed to its ultimate top elevation of 160 and with slopes of 2 on 1 both upstream and downstream during the remainder of the low water season, for which work about eight months during the average year would be available. The material necessary to accomplish this would be about 240,000 yd., and would require the placing of about 1000 yd. per day. Material for this fill would be had in the remnant of the rock piles below the 45 degree line, assumed as the line of fracture.

The general proposition of effecting diversion by means of a mass of loose rock thus precipitated into the channel is submitted as being within the range of practicability. It is believed that the release of this rock at the desired moment and not before, by a blast, can practically be assured by the use of proper explosives and if need be by more than one set of detonators and electric circuits, also that so large a mass of material would reach the bottom of the river channel with such rapidity as to crowd the water in both directions. In this connection it is to be noted that the velocity of the flow in the river channel will probably be not more than 4 or 5 ft. per second at the time of the blast, due to the use of the diversion channel, hence the velocity of flow will not materially affect the disposition of the rock masses in the river channel. Any tendency toward disintegration of the mass of rock as it crowds aside the water, as also the possibility of its assuming flatter slopes than are necessary, can be allowed for by using quantities much in excess of apparent actual requirements.

Before a final and economical design of this dam could be made, much information not now available would need to be obtained by experimental work, especially as to the action of a mass of rock or gravel in settling through and displacing a body of water. Models of the damsite of one or more sizes should be made and the rock slide reproduced with materials of several degrees of fineness, their behavior being carefully observed to deduce the controlling laws.

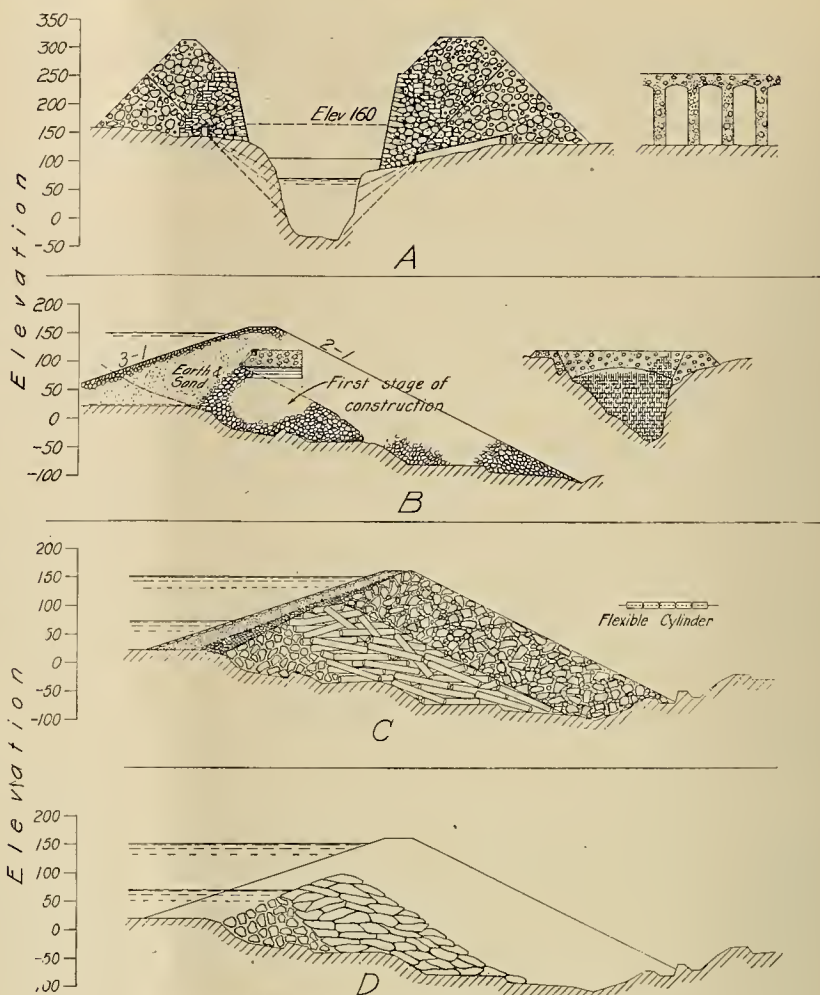


Fig. 30. Suggested Schemes for Loose Fill Dams.

Rockfill dam—Plan B. The second general scheme, that of retaining the material as it is deposited by some sort of barrier or screen to prevent it from escaping, has many variations, but the method which appears to be most practicable is shown in Fig. 30-B. It consists in building across the channel a very heavy concrete arch; in fabricating upon this arch a network of very heavy chains of necessary mesh which would be paid out as fabricated after first securely anchoring the longitudinal elements of the screen in the wide portion of the river above the neck either individually or by attaching them to a heavy cable well anchored on each side of the river. The fill when commenced would, by the superimposed load, rapidly complete the work of anchoring. The rockfill would be deposited from tracks on this bridge until it emerges from the river and effected a complete diversion through the same diversion channel as anticipated for the rock slide plan previously described. After accomplishing the fundamental purpose of diverting the river the fill would then be completed to ultimate elevation during the next season of low flow. This plan possesses the possible advantage of enabling dam construction to be spread over at least two seasons, thereby permitting construction to be carried on throughout at rates of reasonable practicability. After placing the rockfill the dam would be completed by extending the structure upstream by placing finer material, and finally a comparatively water-tight blanket of earth protected by riprap on the upstream face.

The general principles of this scheme are definite and positive, although its successful design and construction require knowledge not now available by which to determine the stresses in the vertical chains.

Rockfill dam—Plan C. For accomplishing diversion by the third basic principle, that of depositing material of size, shape or makeup such that the current cannot move it, several schemes have been proposed, and two are shown in Fig. 30.

It is well established, both scientifically and experimentally, that the ability of a stream to move an immersed body depends upon the latter's size, specific gravity, resistance to movement and exposure to the current. There is probably some size of material which would not be seriously moved by any velocity to which it would be subjected at the damsite under consideration even during high water, but it is certain that the native basalt would not break out by blasting into sufficiently large pieces to accomplish this purpose.

The schemes proposed therefore anticipate the making of artificial units of fill material designed to combine size and weight with a shape offering minimum exposure and maximum resistance to movement.

One scheme which has been suggested is shown in Fig. 30-C. This consists in casting in a position parallel with the channel long reinforced concrete logs or needles, and in launching them off a rollway such as used by loggers but on a larger scale, or by floating them to place on pontoons. These logs would be so handled as to reach a final lodgment in the river below, in a direction on the main parallel to the channel. As compared with their weight they would offer a minimum surface exposed to the dynamic pressure of the water. Their movement through the water in depositing could be controlled to some extent, if necessary, by a line from upstream which could subsequently be detached. They would be built up to a section essentially that of the smaller dam in Fig. 29 although some loose rock from the excavation could doubtless be dumped at the upstream toe to decrease the number of concrete logs required, as shown in Fig. 30-C, and without fear of erosion by the current if kept at all times well below the crest of the log fill. After diversion, loose rock from the excavation would be dumped, as also other materials grading from coarse to fine, on the upstream slope, as shown in Fig. 30-C, until a satisfactory reduction of leakage and the desired crest elevation is reached.

To the right of this sketch an alternative form of fill unit is shown. This would be cast by means of separators into short lengths with convex ends and held together with a heavy central steel cable running from end to end. The purpose of using this flexible principle would be to insure a more compact fill and prevent breaking of the logs in conforming to the bottoms.

After diversion in this manner the fill would need to be completed in one season, as with the other types, by depositing rock in front and upon the top of the fill, and lastly by finer materials on the front as in all loose fill plans.

Rockfill Dam—Plan D. A possible alternative scheme applying the third basic principle for obtaining

units of fill material which would not be carried away by the current is shown in Fig. 30-D. The average rock excavated from the canal and flood channel would be dumped through hoppers into large bags made of a mesh of chains each holding probably from 25 to 50 tons of loose rock. These could be deposited by a traveling crane from an overhead steel bridge or cable-way across the channel and controlled as necessary by a line running upstream, both lines being released when desired. These bags of rock might be made up and stored in some convenient place as in the completed canal, as the excavation progressed so that the actual construction period would be shortened.

The chain bags would be only loosely filled so that they might conform to the bottom. Such a mass could not be moved as easily as could a single piece of equal weight, and they would conform to the bottom better than the concrete logs. While some units of fill material in unstable positions would probably be displaced and carried to the lower toe as a result of high velocities obtaining during the construction period, it is not believed such injury would be sufficient to defeat the scheme, since the stability of the units could be indefinitely increased by increase in size within the limits of practicable handling. Experimental work would be necessary to determine the proper size and makeup of either the elongated concrete cylinder or the chain bag units, to withstand the current during floods.

Plan D, as in the case of Plan C, need not require the exclusive use of artificial fill units. Some loose rock as shown in Fig. 30-D could doubtless be dumped on the upstream toe as the work progressed without danger of erosion by the current. The amount here shown is in both cases a minimum, but the estimates will be based upon the use of special fill units for the entire initial diversion section.

(To be continued.)

THE ATTRIBUTES OF SUCCESS.

Enthusiasm is the thing in a man's makeup which stirs him to make many good New Year's resolutions; determination is the measure of the worth of enthusiasm.

Inspiration leads man to try new things, to seek new ways, to climb; understanding is the attribute which materializes inspiration.

Optimism pulls a man up to a better working plane, keeping him right with himself and with the world; ability crystallizes optimism.

Enterprise starts a man off along new paths; resourcefulness keeps him on the best of those paths and furnishes him with a spur through life.

Initiative lifts man out of his time-worn ruts; fitness keeps him on the crown of the road.

And, above all, responsibility, together with an amalgam of all these attributes, brings success.—Brill Magazine.

JOURNAL OF ELECTRICITY

POWER AND GAS

FOUNDED 1887

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The month of January has been a season of unusual precipitation throughout the entire length of the Pacific Coast. High winds have been of frequent occurrence and floods have arisen where the natural channels were insufficient to carry off excess moisture. An occasional flurry of snow has been seen along the coast, and in the mountains the drifts are piled high.

Yet electric light and power lines have suffered comparatively little damage and power consumers but slight interruption to service. This latter fact is remarkable and is largely due to the great foresight exercised by the companies. Extra linemen and material were in readiness to be rushed to any break and repairs were thus quickly made.

Though electric railway service was interrupted by floods in Southern California the damage was quickly repaired. An amusing situation arose at Portland, where the Portland Railway, Light & Power Company kept its tracks free of snow so that the jitneys could run. Thus does the street railroad company not only develop traffic, install the pavement and maintain it in operating condition—for the use of a parasitic industry. Elsewhere, however, comparatively few jitneys were able to operate during the storms and many people gladly availed themselves of the comfort, safety and reliability of the electric car.

Few people realize the preparation that is necessary to anticipate any interruption to power service and still fewer appreciate the hardships endured by the linemen in preserving continuity of service. Think of working thirty-six hours at a time without sleep and with little to eat, climbing a swaying pole in a gale of wind when a false move brings liability of a high voltage shock, wet to the skin, cold, hungry—the lot of the lineman is not an easy one. His uncomplaining acceptance and his tireless efforts in the face of such difficulties entitles him to the respect, consideration and thanks, not only of his company, but also of the public he is aiding to serve.

Aside from temporary inconvenience, however, the electric light and power companies have suffered little damage from this season's storms. The abundant rainfall is a great blessing, as a whole. It gives assurance of good crops, and an ample supply of water for the generation of hydroelectric power during the year to come.

Complaints are the bugbear of public service corporations. So many complaints are unfounded in fact that it has become the custom among electric power companies, particularly, to install an explainer at the complaint desk, an affable gentleman impervious to insult and quick of wit in devising excuses. This system works admirably for the ninety-nine mistaken complaints, but fails miserably when the one real complaint appears.

Most complaints are due either to alleged overcharges or to service disconnection because of non-payment of bill. In the former case it is usually sufficient to explain the integrity of meter readings and to suggest possible reasons for excessive consumption

Service Continuity During Storms

Anticipating Complaints

of current. In the latter case an appeal to the spirit of fairness ordinarily suffices to show the justice of such action.

But there are times when meter readers make mistakes and there are circumstances when non-payment should be extenuated. Yet the machine-like procedure of the complaint desk is incapable of discrimination and an injustice may be done which brings the blush of shame to the general manager's cheek, an injustice so manifest as to tend to bring the entire organization into disrepute.

How to obviate such occurrences is a serious problem in central station management. Instruction as regards tact and courtesy is not always effective. It is rather much to expect that every representative of the company should possess the same good judgment as would be displayed by the management.

And yet there is a means whereby many complaints can be eliminated. It involves additional care and greater expense, but the care is compensated by the reduction in the number of complaints and the expense is partly balanced by certain errors against the company which can be rectified.

This method requires that each bill be carefully compared with former bills and if any discrepancy be noted that the cause be investigated before the bill is mailed. The comparison should be made with understanding and judgment. It should find out, for instance, that a revenue of one hundred dollars per horsepower of installed capacity in the case of a five horsepower motor is excessive in a city where fifteen dollars is the prevailing revenue. How much better would the customer feel if the company informed him of this fact and offered some restitution instead of allowing the solicitor of a competing company to discover it.

So it must be recognized that there are complaints and complaints. All cannot be classified under the same category and dismissed as figments of the imagination. Wise, indeed, is that company who substitutes a "satisfaction" desk for the complaint desk.

It is reported that the head of a great government bureau at Washington has again "discovered" a grave monopolizing tendency which gives evidence of the existence of a gigantic water power trust and the inference is that additional corporation control is to be proposed for the further disintegration of commercial power. It is indeed strange that even among the most enlightened there is a seeming inability to distinguish between business operations which are essentially monopolistic in their most beneficial intent and those in which monopoly is a menace.

To illustrate the danger of this water power monopoly it has been pointed out that private plants invest more than double the sum than do municipal plants per horsepower developed, though on what basis the comparison is made the reports to hand fail to state. Municipal hydroelectric development is so insignificant compared with that undertaken by private enterprise—else why the fear of private monopoly—

so recent, too, as to have escaped the high cost of pioneering and to have benefited in this respect by costs borne entirely by private enterprise, that it seems impossible, no matter how good intentioned, that any government official could have really found a fair basis of comparison for his development cost figures.

Now the fear of monopoly is that it will destroy competition by destroying the small producer; that it may withdraw its commodity from the market, and by these and other means cause higher prices to be paid for its product than would be the case if monopoly did not exist.

The product of a water power monopoly could hardly be withheld from the market, seeing that it must be sold as made and that its non-use means entire loss, neither could it destroy its competitors, seeing that commission control has—strange vagary of governmental paternalism—found it essential in the interests of economy to eliminate competition and this same safety valve also regulates the price of the product irrespective of the actual amount of the investment.

So it would seem that there is no "grave danger" but rather a national advantage in water power monopoly and the fear expressed but argues against interference with natural law in the business world.

Finally it was definitely proved during the December, 1914, hearings before the Senate Committee on Public Lands that there is no such thing as a water-power monopoly in the United States. Whatever centralization that has occurred has been to promote economy of operation and has no bearing on an attempt to control the output of what is fast becoming a public necessity. This waterpower trust is another of those errors, which, like ghosts, will appear as long as men believe in them; the demand brings the supply.

The United States Supreme Court in its decision upholding the constitutionality of the Alabama water-power condemnation statutes, definitely holds that the states can authorize eminent domain condemnation of power sites and water rights. While this decision applies specifically to state lands, and thus only confirms present practice, there is a possibility that it includes Federal lands. If so, this decision is of far-reaching importance, as it may permit the development of many irrigation and power projects which have been prevented by Federal refusal of rights of way across public land.

In brushing aside the chief objection to this appeal—that the purpose of condemnation is not a public one—Justice Holmes paid a well-deserved tribute to the men who are developing latent waterpowers:

"But to gather the streams from waste and to draw from them energy, labor without brains, and so to save mankind from toil, to supply what next to intelligence is the very foundation of all our achievements. If that purpose is not public, we should be at a loss to say what is."

Many experts believe this decision offers a solution to the controversies that have arisen over oil-land and water power site withdrawals. It is as yet too soon to confirm this hope, as they are based upon brief telegraphic reports of the decision.

A Ghost that Will Not Down

What Constitutes Public Use

PERSONALS

C. B. Aitchison, chairman of the Oregon Public Service Commission, is at Washington, D. C.

H. E. Sherman Jr., Los Angeles representative of H. B. Squires Company, was at San Francisco last week.

F. J. Wallace, of the Wallace & Smith Electric Company of Lodi, California, was a recent visitor at San Francisco.

H. W. Beecher, manager of Chas. C. Moore & Company's Seattle office, was at San Francisco during the past week.

S. C. Bratton, commercial manager for the Portland Gas & Coke Company, is back at his desk after a siege of illness.

W. D. Hayes, proprietor of the Hayes Electric Shop of Santa Rosa, California, spent the latter part of the week on a business trip to San Francisco.

H. D. Shute, treasurer of the Westinghouse Electric & Manufacturing Company, is expected to arrive at San Francisco about the end of the week.

A. J. Meyers, Pacific Coast manager of the Wagner Electric Company, St. Louis, Mo., is expected to return from a short business trip to Los Angeles about the first of the week.

H. M. Jones has resigned as new business manager of the Lewiston-Clarkston Company to take effect March 1, 1916. He has purchased the Fifth street garage at Lewiston, Idaho.

J. J. Jackson, general attorney of the Westinghouse Electric & Manufacturing Company at Pittsburg, Pa., will arrive on the 28th of this month for a short business trip on the coast.

H. W. Cope, in charge of the Westinghouse Electric & Manufacturing Company's exhibit at the P. P. I. E., has finished his work and expects to leave for the East about the first of the month.

A. F. Mencil, of the engineering department of the General Electric Company, who has been stationed at the exposition for the past year, has recently left for the East in charge of one of their 600 ton electric locomotives.

H. S. Jones, formerly salesman with the Busch-Sulzer Diesel Engine Company at San Francisco, has recently severed his connection with that company and has joined the sales forces of the Robbins-Meyers Company at San Francisco.

G. I. Kinney, who has been for the past year manager of the General Electric exhibit at the P. P. I. E., has recently finished the dissembling of the exhibit and has again taken up his headquarters in the Rialto Building, San Francisco.

A. N. Irwin, assistant to treasurer of the Westinghouse Electric & Manufacturing Company, has just returned from a business trip throughout Texas and Arizona, he having experienced considerable excitement along the Mexican border.

I. W. Simpson, Western district manager of the Federal Sign System (Electric) of San Francisco, has just returned to his home office after an extended trip throughout the Western States in company with H. I. Markham, general manager of that company, of Chicago, whom he left at Salt Lake City on his return East.

W. B. Foshay, at one time district Manager of the Washington-Oregon Corporation at Walla Walla, and later manager of the Northwestern Electric Company at Portland, until he took up consulting work at Portland two years ago, is now associated with Page & Hill Co. of Minneapolis, Minn., producers and distributors of cedar poles.

W. D'A. Ryan, illuminating engineer with the General Electric Company, has returned East after submitting to the San Francisco Board of Supervisors a plan for the illumination of Market street with luminous arc lamps from the Exposition.

OBITUARY.

Frank Hastings Varney, engineer of operation and maintenance of the steam-electric department of the Pacific Gas & Electric Company, died at San Francisco, January 21, 1916, after an illness of several months. While his many friends knew of his indisposition the end came as a sad shock to all. Frank Varney was one of the most liked engineers in the West. Starting as an operator in 1893 in the old Station C of what is now the Pacific Gas & Electric Company, he rose by dint of hard work and rare ability to the head of his department, retaining meanwhile the high regard of all with whom he came into contact. He was but 43 years of age at the time of his death and because of his executive ability seemed destined for even greater advancement. Here passeth a man who made this world a better and a happier place for his having lived in it. Funeral services were held January 24th, under the auspices of California Commandery No. 1, Knights Templar. The pallbearers were: John A. Britton, Geo. C. Holberton, P. M. Downing, W. S. Hyde and C. A. Eastwood, representing the Pacific Gas & Electric Company, and C. R. Weymouth, E. O. Shreve and Fred Gay. Mr. Varney is survived by a widow and two young children.

MEETING NOTICES.

Portland Sections A. I. E. E. and N. E. L. A.

At noon, Thursday, January 20th, the regular bi-monthly meeting was held in the dining room of the Portland Commercial Club, with 40 members in attendance. Mr. Glenn Miller of the University of Oregon school of commerce, made an address upon "Business Economics." He pointed out in a brief way how the war in Europe had affected credit in this country, also the money market. He also pointed out what would likely be the conditions after the war was over. J. E. Davidson presided as chairman. At the next regular meeting of the Portland Sections of the A. I. E. E. and the N. E. L. A. to be held February 8th at 8 p. m. in the Electric Building, Portland, Oregon, the speakers of the evening will be Edward Cookingham, cashier of the Ladd & Tilton bank, on the subject of "Financial Lines," and Ben Day, attorney for the Southern Pacific Company, who will speak on "Elementary Principles of Law."

San Francisco Electrical Development and Jovian League.

"Reprisal," or how cutting cut off Leggett for forgetting a birthday, enlivened the league meeting on January 19th. This was an effusion in approved K. C. B. style which preceded the usual introduction of guests and of R. M. Alvord as chairman of the day. Mr. Alvord presented members of the Y. M. C. A., who gave cornet, piano and vocal solos which were greatly enjoyed and then introduced Lyman Pierce, secretary of the Y. M. C. A. as the speaker. Mr. Pierce emphasized the importance of the human element in building a city and showed how the Y. M. C. A. was developing the requisite qualities of virile manhood. He cited several instances where big electric corporations, lumber companies and railroads had delegated much of their welfare work to this organization, paying all expenses, not as a matter of sentiment, but as a matter of sound business. He also showed where the association acted as an ounce of prevention instead of the pound of cure administered by expensive state prisons. He concluded his talk by eulogizing the achievements of San Francisco men in rebuilding the city and carrying through a great exposition and asked their help in assisting the Y. M. C. A. to maintain this high standard of manhood. The meeting was closed by a rising vote of thanks to the speaker and to Mr. Alvord.

Los Angeles Jovian League.

The regular weekly meeting was held Wednesday, January 19th, at Christopher's, with a large and enthusiastic attendance. Henry F. Holland presided, with J. Wesley

Finch acting as chairman of the day, who was responsible for a program which was voted by all present to be a "corking" good one. J. E. McDonald, secretary of the Los Angeles Joint Pole Committee, read a most interesting and instructive paper, "A Brief Outlook on the Blue Sky Law, Prospective and Prospective." He outlined the difficulty of maintaining the distributing systems, in eliminating the unnecessary duplication of poles, of which there are almost 100,000 in Los Angeles today. As an expert, the facts and figures presented concerning pole line construction, maintenance, etc., would indicate that the duplication of poles would be a serious problem, in the event the municipality parallels a portion of the system of the Southern California Edison Company, which it is contemplating doing. It is his opinion that the additional installation of the 70,000 poles necessary, would mean a cost of \$5 annually to every taxpayer. "Duplication has never yet been known to offer a reduction in cost to serve, and a duplication of 45 per cent of the power system would cause a severance damage to the central station, and every unnecessary pole erected in Los Angeles must ultimately be paid for through the customers' meters or by direct taxation."

K. E. Van Kuren commented upon the educational value of the paper, stating that the information it contained should be of absorbing interest to all present, in view of the power situation in Los Angeles at present, and upon his motion the paper was ordered published and distributed.

H. L. Carnahan, state commissioner of corporations, was to deliver an address on the Blue Sky Law, but was detained by storms en route from San Francisco. His visit was looked forward to with pleasant anticipation and his unavoidable absence was regretted by all. He was ably represented, however, by H. W. Bowman, Deputy District Commissioner, who in a simple, forceful manner, gave a resume of the Blue Sky Law, which has been in effect in this State since December, 1914, assuring the league that it is the intention of the commission to be of all possible assistance to corporations in helping to promote and support legitimate business. He stated that \$30,000,000 values in stock, patents and mining claims were escrowed through the commission, and permits issued on \$200,000,000 worth of securities last year. Several splendid musical numbers completed the program.

California Association of Electrical Contractors and Dealers.

The quarterly meeting of the association was held at the Palace Hotel, San Francisco, January 21st, President C. V. Schneider presiding. Annual financial reports were received and the final reports of W. S. Hanbridge, retiring secretary, were adopted. The resignation of L. R. Boynton, because of his removal to Arizona, was accepted and he was elected to honorary membership in both the state and the San Francisco association. Reports were received from the committees on the price book, sample room, telephone specifications and insurance. The by-laws were also revised so as to specify the qualifications for membership.

In the evening a dinner was held at the Palace Hotel, jobbers and central station representatives being invited. This was a most pleasant affair as about ninety were in attendance. M. A. De Lew presided as toastmaster.

In the course of the evening, Mr. Jas. F. Brennan, assistant district attorney, entertained the gathering with stories and recitations.

R. S. Holabird explained the revision in the prices of all heating appliances due to the Nichrome wire patent situation. He also gave details of the method of sale.

J. A. Cleary, electrical inspector with the Board of Fire Underwriters, told of the changes in the new code and explained what it meant to the contractor. He also answered a number of questions regarding the code, including the subject of refillable fuses, making the statement that these

finally had not been approved because a deposit of carbon occurred after continued blowing of the fuse.

Upon behalf of the association, F. J. Somers presented the retiring secretary, W. S. Hanbridge, with a handsome silver service. In accepting this Mr. Hanbridge expressed the pleasure in his past work and pledged himself to continue in his efforts to advance the standing of the association.

D. B. Farquharson then gave an interesting talk as to the reasons for poor business conditions. He stated the building industry of San Francisco represented 45 per cent of the business done in the city and urged that greater recognition be sought by these interests. He showed that whereas the general contractor, architect and the owner is usually blamed for poor business, as a matter of fact the fault lay with the specialty contractor, who is willing to cut prices below a profitable point in order to get the business.

Upon motion of W. S. Hanbridge, the association voted to endorse the proposed scheme of illumination of Market street and instructed the secretary to advise the board of supervisors of their action.

The meeting was brought to a close by an interesting stereopticon lecture on the methods of laying a power cable across the Golden Gate by S. J. Lisberger, engineer of distribution for the Pacific Gas & Electric Company.

The following were in attendance:

H. A. Porter, Porter Electric Co.
J. A. Cleary, Board of Fire Underwriters of the Pacific.
C. F. Butte, Butte Engineering & Electric Co.
S. J. Lisberger, Pacific Gas & Electric Co.
Frank J. Somers, Century Electric Co.
C. V. Schneider, Electric Supply Co.
W. S. Hanbridge, Hanbridge Electric Co.
J. G. Creighton, Pacific Coast Spec. Co.
J. W. Wood, Pacific Coast Spec. Co.
Hal Lauritzen, Pacific States Electric Co.
M. Fortini, Standard Electric Const. Co.
Nathan A. Bowers, Electrical World.
R. T. Kahn, Electric Railway & Manufacturers' Supply Co.
F. C. Porter, The Electric Shop, Oakland.
J. Gensler, Electrical Const. Co., Oakland.
D. E. Harns, Pacific States Electric Co.
R. V. Oyler, Capitol Electric Co.
Hugh Kimball, Kimball Electric Co.
R. E. Fisher, Pacific Gas & Electric Co.
C. J. Newbery, F. E. Newbery Electric Co.
F. H. Mills, Electric Appliance Co.
W. T. Kohlwey, Kohlwey Light Co.
Geo. G. Drew, Pacific States Electric Co.
S. G. Jackson, Berkeley Electric Const. Co.
G. H. Andrews, Contractor, Oakland.
S. Bushman, Oakland.
F. J. Wallace, Wallace & Smith Elec. Co., Lodi, Cal.
Geo. D. L. Smith, Electric Motor & Machine Co.
A. A. Elick, Pacific States Electric Co.
Geo. H. Curtiss, Pacific States Electric Co.
C. L. Gilson, Gilson Electric Supply Co.
W. S. Berry, Western Electric Co.
R. D. Holabird, Holabird-Reynolds Co.
F. J. Cram, Electric Appliance Co.
T. O. Dowdell, Solano Supply & Const. Co.
Arthur J. Maloon, Oakland, Cal.
H. I. England, Gilson Electric Supply Co.
S. L. Hancock, Rex Electric Co.
A. H. Nylan, Gilson Electric Supply Co.
C. S. Renwick, Pioneer Electric Co.
R. F. McDonald, Holabird-Reynolds Co.
Robt. King, King's Electric Co.
Wm. Beamin, Gas & Electric Appliance Co.
V. A. Kuehn, Gas & Electric Appliance Co.
A. H. Halloran, Journal of Electricity, Power and Gas.
D. J. Collins, Pacific Electric Mfg. Co., Richmond.
B. J. Ballantigan, Pacific Electric Mfg. Co., Richmond.
E. A. Crowson, Western Electric Co., Oakland.
V. B. Gilpin, Piedmont Electric Co., Oakland.
M. F. Nagle, Bay Electric Co., Oakland.
E. W. Lauer, Rex Electric Co., San Francisco.
H. H. Hoxie, Electric Railway & Manufacturers' Supply Co.
T. J. Bennett, Rex Electric Co., San Francisco.
M. E. Ryan, Redwood City.
Thos. H. Nernes, Pacific States Electric Co., San Francisco.
J. A. Foster, San Mateo, Cal.
W. C. Martinez, Western Electric Co.
B. C. White, Contractor, Berkeley.
N. P. Ellis, Oakland Electrical Co.
Geo. A. Sittman, General Electrical Const. Co.
M. E. Hickox, Pacific States Electric Co.
J. A. Richmond, Decker Electrical Const. Co.
M. L. Scobey, Home Electrical, S. F.
H. C. Herning, Electric Railway & Manufacturers' Supply Co.
C. L. Chamblin, California Electric Const. Co.
T. H. McDonnell, California Electric Const. Co.
A. Youngholm, Electric Railway & Manufacturers' Supply Co.
W. L. Neelands, Western Electric Co.
B. Badrian, Pacific States Electric Co.
H. E. Coyle, South San Francisco.
M. A. DeLew, San Francisco.
Wm. E. Hayes, Santa Rosa.

SOUTHERN CALIFORNIA EDISON CONDEMNATION HEARING.

At the conclusion of the testimony of S. M. Kennedy before the Railroad Commission of California in its hearing on the condemnation of the company's distribution system in Los Angeles, (as reported in this journal, Jan. 15, 1916), Dr. Geo. L. Hoxie was recalled to explain projected curves on the company's historical chart.

Mr. Ballard then again took the stand and testified that in order to secure the recovery of its peak or maximum demand upon its generating system, to replace the maximum demand in Los Angeles business, the company would be required to spend a total of \$4,438,380.17 in the next eight years for extensions and additions to its distributing properties outside of Los Angeles and some small additions to its generation and transmission system to secure the maximum possible efficiency.

The expenditures by years were estimated as follows:

Year ending June 30, 1916.....	\$ 458,800.00
" " " " 1917.....	468,800.00
" " " " 1918.....	478,800.00
" " " " 1919.....	498,800.00
" " " " 1920.....	508,800.00
" " " " 1921.....	601,374.40
" " " " 1922.....	673,827.35
" " " " 1923.....	749,178.42
Total	\$4,438,380.17

After the expenditure of this large sum of money, Mr. Ballard estimated that the company would have recovered its maximum demand upon its generating stations, but owing to decreased efficiency caused by the separation of the Los Angeles business from the system, the kilowatt hour sales would be 30,000,000 a year less than before severance, resulting in a decrease of \$950,000 a year in gross earnings.

Mr. Arthur R. Kelley, formerly electrical engineer with the railroad commissions of the states of Washington and California, testified that he had been at work for the past sixteen months making an inventory and appraisal and a general study of the property of the company and a determination of all items of value, both physical and commercial, as well as the large severance damages.

Mr. Kelley at this point in the case gave the result of his study of the condition of the entire properties of the company with respect to accrued depreciation. He testified that all of the properties of the company were maintained in a very high state of efficiency, the depreciated value of the general properties, including power plants and transmission lines, being 85 per cent of their cost and of the distributing properties of the company, both inside and outside of Los Angeles, 80 per cent of their cost.

Expert Gillette on Depreciation.

Mr. Halbert P. Gillette of New York, formerly chief engineer of the railroad commission of the state of Washington, testified to an experience of twenty-three years of engineering work involving inventories and appraisals of public utility properties amounting to six hundred and seventy-five millions of dollars.

He was employed by the company six months ago especially to study its properties with a view of determining exactly the amounts which should be fairly allowed annually, in addition to regular operating expenses, for depreciation in order to maintain the properties in a high state of efficiency.

Mr. Gillette testified on the subject of depreciation, stating the allowance which should be made to the company for this item in connection with the property remaining to it outside of Los Angeles, starting with an allowance of \$534,279 for the year 1916, with increasing allowances each year thereafter, to a total of \$673,878 in the year 1923, during which year the company estimates it will have the same peak demand upon its generating system in business outside of Los Angeles as it had during the year 1915 when its business included both Los Angeles and outside territory.

Mr. Gillette defined his method of arriving at the cost of depreciation as the cost, or historical method, of arriving at depreciation, current repairs and maintenance, rather than a method based upon the assumption of different lives for different classes of equipment. It is a complete method of determining what has happened in the past nineteen years' history of the company.

Dr. Hoxie followed and under examination of Mr. Dunne testified that he was familiar with the method of expressing the percentage for the depreciation annuity reserve as computed by Mr. Gillette and considered it distinctly preferable to any method yet suggested for that purpose.

President Edgar on Severance.

Charles L. Edgar, president of the Edison Electric Illuminating Company of Boston, gave a deposition on severance damage which was presented at the hearing. In reviewing the growth and scope of his company's operations, Mr. Edgar stated the capitalization had increased from \$100,000 in 1887 to approximately \$45,000,000 at the present time. It has the unique distinction of carrying no bonded debt and its excellent financial condition is reflected in the high price of its capital stock, which price is regulated by public authority. The gross earnings of the company are approximately \$7,500,000, about two-thirds of which is derived from the city of Boston, the balance from its operations in suburban territory.

The company supplies electric energy to 40 municipalities and in the city of Boston its operations cover the entire city with practically no competition.

In outlining his method of determining the amount of damage Southern California Edison Company would suffer by the severance of its Los Angeles property and business from the balance of the system, Mr. Edgar stated that he had applied this same method some years ago in his own company.

In speaking of diversity of demand and its direct connection with economic and efficient operation of electric companies, Mr. Edgar stated the Southern California Edison Company had a remarkable condition in this respect, due to the lighting business in Los Angeles, whose peak occurs in the winter, and the irrigation business in the outside territory, whose peak comes in the summer. This extraordinary condition, which enables the company to supply a larger demand with less installation, would be entirely destroyed by severance, the character of the business permanently changed, and the value of the business decreased accordingly.

Mr. Ballard analyzed the deposition of Mr. Edgar. In reviewing the document, Mr. Ballard applied figures relative to costs, earnings, etc., for the year ending June 30, 1915, to the method outlined by Mr. Edgar determining severance damage and showed that according to Mr. Edgar's method of calculation, the severance damage would be \$11,096,283.88. This method involves the analysis of the cost of the property to provide for the elimination of the Los Angeles distributing system and a complete analysis of all items of earnings, and operating expenses to show what reductions would be made by the loss of the company's Los Angeles business. With this determined, projections of earnings, operating expenses, additional capital requirements and load conditions on generating plants were made for a period of eight years in the future to arrive at the time when the addition of business outside of Los Angeles would have resulted in a maximum, or peak, load on generating stations equal to the peak load of the combined system at the present time.

It was shown that the company would be required to spend in the districts outside of Los Angeles \$4,438,380.17 to secure new business; its depreciation account would increase from \$471,000 per annum to \$614,000 per annum, and its operating expenses from \$1,222,000 per annum to \$1,607,000 per annum. During the same period its gross revenue would increase from \$2,318,000 per annum to \$3,477,000 per annum in this outside territory.

While the combined system before severance was earning net 7.9 per cent, its net earning in 1923 would be \$524,000 less than 8 per cent per annum, which is considered by the railroad commission to be a minimum fair return on the cost of its property used to supply the service.

The annual deficits below 8% were then computed, showing that in 1916 this deficit would be \$815,000 reducing gradually each year until in 1923 the deficit would be \$524,000. The damage caused by these deficits, figured as of the present time, allowing compound interest on the funds at 4 per cent per annum until needed for payment of bond interest and operating expenses, would be \$4,588,035.25. The permanent damage, calculated as of the year 1923, and allowing compound interest in the meantime, was arrived at by capitalization of the 1923 deficit and amounted to \$6,508,248.63. The sum of these two items constitutes the severance damage, \$11,096,283.88.

Mr. Ballard also explained in great detail the importance of a fair interest rate on depreciation annuities—which the company in all its calculations in this case had assumed to be 4 per cent per annum.

Mr. Insull Says Economic Crime.

Mr. Samuel Insull, the foremost operator of public utility properties in the United States, was the next deponent on the question of severance damage. He firmly and ardently declared that in the electric industry, economies in operation are to be effected chiefly by concentration of production and a unified system of distribution.

Mr. Insull brought out emphatically that the economic trend in the distribution of electric energy is toward very large distribution systems with a few large power stations; the reason being that experience has proven that is the only way to get the lowest possible cost and consequently the lowest possible selling price to the consumer.

As an illustration of this, he cited the case of a company in his territory, serving a small community, which by consolidation of plants and distribution systems more than doubled the number of consumers in a period of two years. At the same time, the number of towns served doubled; the kilowatt hours sold trebled; the gross income doubled; the income per kilowatt hour decreased nearly 20 per cent; and the load factor doubled.

Where a concentration of properties into a unified, connected system has resulted in advantageous diversity condition and advantageous load factor, such as pertains to Southern California Edison Company, Mr. Insull stated that a separation of any part of such system from the whole, with the consequent disruption of these conditions and enormous destruction of values, would result only in waste, to be borne by the community, and is an economic crime.

Mr. Insull, in his method of calculating severance damage, divided the damage into four different items; the investment damage due to loss of diversity; the operating damage due to loss of diversity; the fixed charges on idle investment; and the damage due to the difference between 8 per cent net return on investment obtainable without severance and continuance of present basis on which foregoing calculations are based.

Following the introduction of Mr. Insull's deposition, Mr. Ballard submitted a computation based upon Mr. Insull's method showing total severance damage in the sum of \$10,945,039.57.

Mr. Ballard, the last witness for the company, testified briefly on each item of the total claim for just compensation.

In closing his testimony, Mr. Ballard submitted two methods of determining just compensation as viewed strictly from the financial standpoint.

The "Banker's Method" embodied two calculations; one, assuming the amount paid as just compensation to be used for the retirement of all bonds outstanding and the remainder reinvested in new property; the other assuming the retire-

ment of underlying bonds secured by mortgages which specifically include the Los Angeles property and the balance deposited in Special Trust Fund for future construction expenditures.

Just compensation by the "Banker's Method" amounts to \$22,551,431.60.

The "Method to Preserve Equities of Bondholders and Stockholders," as its title implies, covers the question from the standpoint of the bondholder and stockholder. It stipulated that just compensation has been made when, and only when, all persons who have rights against the properties are left in a position substantially as favorable as that occupied by them before their property was taken.

By this method the just compensation would be \$23,630,603.30.

To both of the above methods should be added such an amount as is determined will be the cost of reconstructing transmission lines in order to remove all lines from Los Angeles city.

APPLICATIONS TO CALIFORNIA WATER COMMISSION.

Charles E. Manley of Stauffer, Ventura County, has applied to the commission for permission to appropriate 3 second feet of water from Bitter Creek, a tributary of Lockwood Creek, at a point in the SE $\frac{1}{4}$, S $\frac{1}{4}$, SE $\frac{1}{4}$, Sec. 27, Tp. 8 N., R. 21 W., S. B. M. Applicant proposes to irrigate 430 acres, conveying the water to his land by a ditch approximately a mile in length. J. S. Manley and Geo. Wessemann of Fowler are witnesses to the application.

The Death Valley Consolidated Mining Company of Los Angeles has applied to the commission for permission to appropriate 10 miner's inches of water from Willow Creek, which sinks into Death Valley.

Edward E. Elder and F. L. Young of Lone Pine and Keeler, have asked permission of the commission to divert for agricultural purposes, 2½ second feet of the waters of Panamint Canyon, from a point in Sec. 6, Tp. 21 S., R. 45 E., M. D. M., Inyo county. A pipe line three miles long, at an estimated cost of \$2500 is proposed to conduct the water to irrigate 320 acres of lands of applicants.

Jos. R. Ghiselin of Los Angeles has applied to the commission for permission to appropriate 375 second feet of water from Piru Creek, tributary to the Santa Clara River in Ventura county for hydraulic mining. The diversion is asked from the SE $\frac{1}{4}$, SE $\frac{1}{4}$ of Sec. 14, Tp. 7 N., R. 19 W., S. B. M. The application sets forth that the water is to be diverted by means of a concrete and timber dam, and there is an intended storage reservoir with a capacity of 9100 acre feet, with a storage dam also constructed of concrete and timber. The water, according to the application, is to be conveyed by a pipe line and ditch, twenty miles long and terminating in Temescal Rancho. The water is to be used to mine out auriferous gravel deposits. The estimated cost of the works is given at \$250,000. Lewis Cruckshank and John F. Clark, both of 1326 Washington street, Los Angeles, are given as witnesses to the application.

C. E. Williams of Yuba City has applied to the commission for permission to appropriate 20 second feet of the waters of Snake River Drainage Ditch, tributary to Sutter Tule Basin, in Sutter county. The proposed point of diversion is in the NE $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 3, Tp. 13 N., R. 3 E., M. D. M. The water is to be used for irrigation purposes and there are a removable timber dam to allow of the escape of the flood waters, and five-mile ditch in the proposed works.

The California Chief Development Company of Forest Hill, Placer County, has applied to the commission for permission to appropriate 80 miner's inches of Owl Creek tributary to the North Fork of the American River, for mining purposes. W. Fitch is president of the company.

Oscar and Etta Glanville of Majave, Kern county, have applied to the commission for permission to appropriate for agricultural purposes, four second feet of the water of Cotton-

wood Creek, in Sec. 29, Tp. 30 S., R. 36 E., M. D. M. There is proposed a diversion dam 40 ft. high, 150 ft. on top and 100 on bottom, built of concrete, masonry and broken rock, at a cost of \$17,500. A main ditch $3\frac{1}{2}$ miles long is intended to carry the water to 239 acres to be watered.

The Lindsay-Strathmore Irrigation District, with headquarters at Lindsay, Tulare county, has applied to the commission for permission to divert water from two streams for the purpose of irrigating some 15,500 acres in that district. The first diversion is asked from the South Fork of the Kaweah River, being for 15,000 acre feet. A diversion dam and a storage reservoir capable of holding 22,000 acre feet of water, with a ditch and tunnel 6 miles long are included in the works, which it is estimated will cost approximately \$450,000. The second source of diversion is the North Fork of Tule River, where it is asked that an appropriation of 12,000 acre feet be granted. There is also a ditch and tunnel five miles long connected with this diversion and a storage reservoir. The cost of the works of this diversion is estimated at \$150,000. The applicant sets forth that it will take two years to complete the works and that it will be three years from that time before the whole district will be brought under the ditches. The commission has allowed the district sufficient time in which to file maps and other more complete data.

BOOKS REVIEWED.

"Inventions and Patents," by Philip E. Edelman; 288 pp., 5x8 in. Published by D. Van Nostrand, New York, and for sale by Technical Book Shop, San Francisco. Price, \$1.50.

With the avowed purpose of clearing some of the misunderstanding regarding patent matters, the author discusses the patent system and the U. S. Patent Office, giving the steps necessary to secure patent and ideas as to protecting and disposing of patent rights. The style is readable and the treatment thorough. The book is filled with information which should be known by anyone wishing to get a patent or invest in one.

"Principles and Practice of Cost Accounting," by Frederick H. Baugh; 180 pp., 6x9 in. Published by the author, Box 682, Baltimore, Md., and for sale by Technical Book Shop, San Francisco. Price, \$3.00.

This treatise presents the elements of cost accounting so that any accountant or engineer should be able to adapt it to any job with a minimum of trouble. It deals primarily with manufacturing costs, whether of simple job, departmental or process. Examples are given of the application of principles in typical cases. A careful study should enable any manufacturer to comply with the first commandment of business—"Know thy costs."

"Theoretical Elements of Electrical Engineering," by C. P. Steinmetz; 368 pp., 6x9 in. Published by McGraw-Hill Book Co., New York City, and for sale by Technical Book Shop, San Francisco. Price \$3.00.

This fourth edition of Dr. Steinmetz's well known work represents a radical revision and almost a complete rewriting of the text. This book now contains only the most fundamental principles of the general theory and of such special apparatus as synchronous machines, direct current commutating machines, synchronous converters, the alternating current transformer and induction machines. In conformity with the decision of the International Electrical Congress at Turin, the crank diagram of vector representation is used instead of the polar diagram. A knowledge of the calculus is essential to the intelligent study of this treatise.

"Essentials of Electrical Engineering," by J. F. Wilson; 345 pp., 6x9 in. Published by D. Van Nostrand Co., New York, and for sale by Technical Book Shop, San Francisco. Price \$2.50.

As is implied by the title this text presents what, in the author's opinion, are the essential things to be known about electrical engineering in general before specializing on any branch in particular. The non-essentials are omitted and most of the mathematical developments are printed in small

type appendices in the back of the book. The author is instructor in electrical engineering at the University of Michigan. The book is an excellent one for the use of students studying any branch of engineering as it lays the ground work of the fundamental laws of the electric circuit, both direct and alternating current.

"Wireless Telegraphy," by Dr. J. Zenneck, translated by A. E. Selig; 443 pp., 6x9 in. Published by McGraw-Hill Book Co., and for sale by Technical Book Shop. Price \$4.00.

During the five years since Zenneck's book has become a standard to many German speaking engineers, its merits has been inaccessible to many English speaking experimenters. Consequently this excellent translation should be accorded a hearty welcome. It is by no means an elementary treatise, as an understanding of the calculus is essential to its use. It places the subject on a scientific basis and should be indispensable to professional and well educated amateurs. The text is divided into fourteen chapters. The first two deal with oscillations of the condenser circuit, including determination of frequency, methods of damping and a description of the various types of open oscillators. The next two chapters are concerned with circuits, the high frequency a.c. circuit and coupled circuits. Resonance curves are thoroughly discussed and the antenna is described in detail as regards various kinds. Three chapters are devoted to transmitting of damped and undamped oscillations, full details being given of the various methods in use. Then follows a theoretical treatment of the propagation of waves, and then chapters on detectors and receivers. The concluding chapters are devoted to directive telegraphy and wireless telephony.

PUBLICATIONS RECEIVED.

Report of the Idaho Public Utilities Commission, Boise, Idaho from July 1, 1914, to June 30, 1915; 406 pp., 6x9 in.; full text of formal applications, general orders and statistics of all utilities in the state.

Bulletin 100, U. S. Bureau of Mines, "Manufacture and Uses of Alloy Steels," by Henry D. Hibbard, gives properties, methods of manufacture and treatment of tungsten, manganese, chromium, nickel and silicon steels.

Bulletin 97, U. S. Bureau of Mines, "Sampling and Analyzing Flue Gases," by Henry Kreisinger and F. K. Ovitz, gives detailed information for engineers in charge of boiler plants as to promoting boiler room economy.

NEW CATALOGUES.

Regent Semi-Indirect Bowls for decorative and commercial lighting are attractively illustrated and described in Catalogue No. 108 issued by the Ivanhoe-Regent Works and being sent to interested parties by the Pacific States Electric Company. In addition to beautiful full-page halftones of the various styles in Veluria, Druid and Sudan glass, with accompanying text, this catalogue gives engineering data as to most efficient methods of installation.

The sixth edition of "How to Figure Illumination and a Complete Catalogue of Sunbeam Mazda Lamps" has just been published by the Western Electric Company, Inc. This booklet gives tables and complete illuminating data, as well as picturing and describing the various sizes of Sunbeam Mazda lamps.

Bulletin 12, dated January, 1916, is the latest piece of literature describing Cutler-Hammer Lifting Magnets. This 24 page bulletin contains over 40 illustrations and interesting information concerning the design, application, cost of handling various materials, etc. A circular describing briefly the Cutler-Hammer Magnetic Separator Pulley is being sent to various industries that have use for this device, including paper and pulp mills, cement plants, gypsum plants, starch mills, foundries, steel plants, mines, glass factories, rubber plants, and others.



INDUSTRIAL



AN IMPROVED METHOD OF WINDING HIGH TENSION TRANSFORMERS.

A method of winding high tension transformers intended to dispense with the necessity of "pies," and greatly reduce the voltage between adjacent wires or parts of windings, has recently been devised by S. M. Gardner, designing engineer for the Western Transformer Company of Oakland, Cal.

In order to keep the voltage between layers and adjacent parts of the windings of high tension transformers down to a safe working basis, the high tension windings are at the present time divided into a great many small coils called "pies" so that the layers will be short, with but few turns per layer. It is considered good practice in the designing of high voltage transformers not to exceed 150 volts between layers or 2000 volts per coil section. If each coil generates 2000 volts, then there will be 40000 volts between the

Thus these windings should be durable, because of decreased mechanical and static strain between parts of the windings. It should be efficient, because of less material and hence less losses. Be lighter for handling and shipping, cost less to manufacture, have good regulation, because of arrangement of the coils and reduced copper, require less insulating tape and hence radiate the heat better to the oil, and thus operate cooler.

TRADE NOTES.

The sentiment in favor of displaying a U. S. flag by hotels, clubs, theaters, etc., is suggested by the lamp companies as an opportunity for the central station to boost the use of electric flags with colored lamps.

The Western Electric Company is offering \$250 in prizes for window displays of fans, using a display cutout furnished by them. Ten prizes are offered and in addition one dollar will be paid for each photograph submitted.

The business of the General Electric Construction Company of San Francisco has been segregated into a retail sales and an electrical contracting department. Geo. A. Sittman continues to act as manager of the General Electric Construction Company, while M. L. Scobey handles the retail department under the name of the Home Electrical.

NePage, McKenny & Company, of Portland, have been awarded a contract to install the electrical equipment on the lift span for the big intrastate bridge spanning the Columbia River at Vancouver, Wash. The work will involve the installation of two 150 horsepower motors. They have also been awarded a contract for the electrical installation in the new Bellingham high school building.

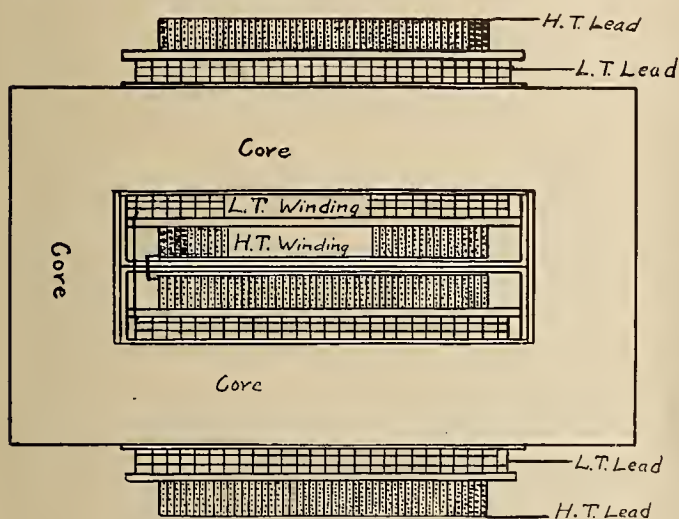
The United States Fuel Ship "Mars" arrived in San Diego the middle of January carrying 150 tons of the government exhibit which will be displayed at the Panama-California International Exposition through the entire year 1916. The government will participate in the 1916 Exposition to as great an extent as in San Francisco. At least a half-dozen bands, and artillery, cavalry, marine and infantry troops will be in the exposition grounds during the year. The scope of the San Diego exposition has been increased so greatly for 1916 that the directors have found it necessary to change the name to read "Panama-California International Exposition." Canada, Russia, France, Italy, Germany, Brazil, The Netherlands and Switzerland, are installing big displays—the greater part of them brought from the San Francisco exposition. Other features of the beautiful exposition have been enlarged so that the dedication of the new exposition, March 15th, is more than a matter of form.

NEW CATALOGUES.

Westinghouse Electric Fans for 1916 are attractively portrayed in Catalogue 8-A from the Westinghouse Electric & Manufacturing Company.

Curtis Steam Turbine Generators are carefully described and beautifully illustrated in Bulletin No. 42,206 from the General Electric Company. The principles of operation are clearly shown and the methods of construction described.

Bulletin No. 44,409 from the railway department of the General Electric Company illustrates and describes ventilated commutating pole railway motors for 240, 600 and 1200 volt operation. Bulletin No. 43,253 from the supply department is devoted to luminous series arc lamps for operation on d.c. circuits of 4, 5 and 6.6 amperes (pendent types). Bulletin No. 47,409 from the switchboard department presents pictures and text regarding small capacity industrial oil switches for 3-phase induction motors of 10 h.p. or less.



Winding for High Tension Transformers.

outer edges of adjacent coils. This requires considerable insulation to separate the two in order to withstand safely the continued static stress. Also considerable valuable winding space is taken up by this insulation.

It is mainly this minor insulation which increases the size of high voltage transformers as well as their weight, and decreases their efficiency when compared to the same capacity of lower voltage. The cost of manufacture of high voltage transformers is greatly in excess of that of the lower voltage, this being due partially to the minor insulation just mentioned, partly to the cost of the material and the increased labor.

If instead of winding the high tension coils in layers lengthwise with the central magnetic core they are wound in layers transverse to the core, the layers need not be long, and therefore the voltage between layers is kept very low, without any sub-dividing. There is also little mechanical as well as static stress between layers. In very large transformers, or where the wire is small, an insulating ring of paper may be placed between each layer of wire. Thus the winding is nearly as compact as that for the low voltages. The increase in voltage is gradual from one end to the other of the winding. The winding may be kept thin and need have little or no covering of insulation or tape between it and the surrounding oil for cooling it.

The two leads of the coil can be brought out at the outer edges. The wire is wound with each succeeding turn concentric with the others to the same layer.



NEWS NOTES



FINANCIAL.

SAN FRANCISCO, CAL.—The Great Western Power Company of California has been authorized by the railroad commission to spend the proceeds from the sale of \$5,000,000 face value, ten-year 6 per cent convertible gold debentures, practically in accordance with the application of the company. The money from the sale of not over \$3,000,000 worth of debentures may be used to buy \$4,988,000 face value of the capital stock of the City Electric Company. The money received from the sale of \$2,000,000 of debentures may be used to buy from the Western Power Company at not over 90, the following bonds: Eight hundred and forty-nine thousand dollars first mortgage 5 per cent forty-year sinking fund gold bonds of the Great Western Power Company, \$1,050,000 of first mortgage 5 per cent thirty-year sinking fund gold bonds of the City Electric Company. A stipulation is made by the commission that the Great Western Power Company of California, before spending any of the money to buy the City Electric stock, shall first secure from the commission an order stating that the Great Western Power Company has agreed that it will use \$3,000,000 to be received from the sale of the City Electric Company's stock only after the commission has authorized the expenditures. By previous decisions of the commission the Great Western Power Company of California was directed to use the proceeds from the sale of the \$5,000,000 of bonds mentioned for the purchase of the stock of the City Electric Company, as now authorized, and besides \$1,500,000 for the construction of two transmission lines from Big Bend to Oakland and \$250,000 for two cables across the bay. Later the Great Western Power Company of California asked to apply to the purchase of the bonds of the Great Western Power Company and City Electric Company that portion of the proceeds obtained from the sale of its debentures which heretofore it had agreed to spend for the transmission lines and cables. It was testified that the proposed program had not been abandoned but that part of the \$3,000,000 to be paid for City Electric stock will be used for these improvements.

INCORPORATIONS.

VENTURA, CAL.—Articles of incorporation for Conejo Mutual Water Company have been filed. The articles provide for the acquiring of wells, engines and pipe lines to carry water to the property of the stockholders of the company. It is planned to develop the necessary reservoir systems and rights of way. The principal place of business is the ranch of C. E. Utt and Sherman Stevens, seven miles east of Camarillo. The capital stock is \$25,000.

BAKERSFIELD, CAL.—The Pacific Light & Power Corporation has filed articles of incorporation in Kern county, with the following seven as a board of directors: Wm. G. Kerkchoff, Kaspare Cohn, Chas. Forman, W. N. Kemp of Los Angeles; George S. Patten and Howard E. Huntington of Pasadena, and H. E. Huntington of Oneota, New York. Capital stock is \$40,000,000, with \$7000 subscribed, a thousand dollars by each of the named members of the board of directors.

ILLUMINATION.

CENTRALIA, WASH.—The power dam of the Central Light & Power Company was destroyed in the recent high water.

SANTA ANA, CAL.—The bid of the Palmer Motor Company for ornamental lights has been accepted. The cost will be \$9920.

SPOKANE, WASH.—The installation of a curb lighting system on Sprague avenue is being asked by property owners on that street.

PROSSER, WASH.—A \$12,000 bond issue will soon be put to a vote of the people. The city council is considering the matter of constructing a municipal light plant.

WEISER, IDAHO.—The city council has granted the Weiser Oil & Gas Company a franchise in this city for 50 years. The company will begin at once laying pipes.

ONTARIO, CAL.—The city council has awarded a contract for the installation of an electrolier street lighting system to the Granger-Hall Electric Company of Ontario.

SEATTLE, WASH.—Specifications for 34,000 ft. of cable and wire for the new city hall have been approved by the council. Bids will be called for soon by the purchasing agent.

LA GRANDE, ORE.—The Mill Creek power plant of the Eastern Oregon Light & Power Company was destroyed by fire January 17th. Work of rebuilding will be started at once.

LOS ANGELES, CAL.—The department of public service will receive bids for street lighting equipment in accordance with plans and specifications on file with the board, up to February 15th.

PASADENA, CAL.—The city commission has awarded the contract for the installation of ornamental street lights on a portion of Prospect boulevard, terrace and square, to Chas. C. Glass on his bid of \$4890.

PHOENIX, ARIZ.—When bids were opened for the installation of an ornamental lighting system here the bid of the New State Electric Company for \$18,055 was the only one complying with the plans.

SAN DIEGO, CAL.—A contract for maintaining festoon lights on Broadway, Fifth and Twelfth streets and supplying electric current therefor during 1916 has been awarded to the San Diego Consolidated Gas & Electric Company.

FRESNO, CAL.—The board of trustees has adopted a resolution of intention for the construction of an electrolier street lighting system upon J street from Merced to Tuolumne streets, and upon Tuolumne street from J to I streets.

LOS ANGELES, CAL.—Specifications for street lighting equipment in the East Los Angeles-Garvanza-Highland Park district and Hollywood and East Hollywood district have been approved by the public service commission. Bids for equipment will be called for at once.

LOS ANGELES, CAL.—A petition has been filed with the board of supervisors asking for the establishment of a highway lighting district to be known as the Graham lighting district of Los Angeles county. A hearing on the petition will be held by the board on February 7th.

EUGENE, ORE.—Cluster lights similar to those on Willamette and Olive streets, will be erected on Eighth avenue E. between Willamette and Pearl streets. The county court has signed a petition for the lights, and it will be presented to the city council at its next meeting. Twelve posts are required.

LOS ANGELES, CAL.—The purchase by Eastern capitalists of the Southern California Edison Company's gas plants at Pomona, Long Beach, Santa Monica, Venice, San Pedro, San Dimas, Lordsburg, Ocean Park and Claremont has been officially announced. The Edison Company's Santa Barbara plant is not included in the deal. The price paid is estimated at from \$3,000,000 to \$4,000,000. F. R. Bain, president of the Southern Counties Gas Company, is among the principal contributors to the purchase. It is understood the properties will be used in the proposed reorganization and development of the Southern Counties Company from a \$2,000,000

to a \$10,000,000 corporation, natural gas being used. It is said the Edison Company will give up its gas holdings and become an electrical organization exclusively.

TRANSMISSION.

BOISE, IDAHO.—A certificate of convenience and necessity has been issued to the Southern Idaho Water Power Company to extend its distributing lines to Power and Bingham counties, to furnish electrical energy for light and power.

BAKERSFIELD, CAL.—Contracts for nine electric plants for pumping water in the Weed-Patch district have been signed up by Manager E. A. Farrow of the San Joaquin Light & Power Corporation and extensions of power lines for a distance of 11 miles will be built at once.

CARLSBAD, N. M.—It is estimated the cost of improvements begun by Carlsbad Utilities Company will amount to \$20,000. The system is being changed from 2300 volt to 6600 volt, 3-phase. Six transformers, new generator, new motor and pump will be installed.

QUINCY, CAL.—Geo. H. Hall of Taylorsville has applied to the board of supervisors for a franchise to erect an electric power line for the distribution of electricity in Taylorsville and vicinity. The board has ordered notice of intention published to grant the franchise to the highest bidder on March 16th.

SAN BERNARDINO, CAL.—The Pacific Light & Power Company has been granted a franchise to construct and for fifty years to operate an electric pole and wire system, for transmitting electricity for lighting, heating, and power purposes, upon all public highways in San Bernardino county. The ordinance to take effect February 10th.

YREKA, CAL.—Several changes were made in the management of the California-Oregon Power Company following the annual meeting. Officers were elected as follows: J. D. Grant, president; J. D. McKee, Alex. J. Rosborough and Jesse W. Churchill, vice-presidents; I. C. Thompson, secretary; executive committee, Jesse W. Churchill, J. Henry Meyer, J. D. Grant, Alex. J. Rosborough, Joseph Hyman and Joseph A. Donohoe. The corporation is the successor of the Siskiyou Electric Power & Light Company. It supplies 34 communities with light and power in Northern California and Southern Oregon and is building an additional plant on the Klamath River to generate 53,000 h.p.

TELEPHONE AND TELEGRAPH.

PASADENA, CAL.—The city has appropriated \$300 to construct a telephone line from Pasadena to patrolmen's headquarters back of Switzer's Camp.

SAN DIEGO, CAL.—An ordinance granting to the Postal Telegraph Company permission to lay wires underground on E and G streets, between Fifth and Sixth streets, has been passed by the council.

WAPATO, Wash.—Residents of White Swan and vicinity are anxious to have a telephone system installed in that locality. Several of the ranchers have stated that if a telephone system is brought to White Swan and a central office established they will bear all expenses of construction.

SANTA BARBARA, CAL.—That negotiations have virtually been concluded for the merging of the two local telephone companies is admitted by E. A. Gilbert, president of the Home company, and by George Bush, until recently assistant general manager at San Francisco of the Pacific Telephone & Telegraph Company, which operates the other system. The lines are to be taken over by a third company, which Bush represents. Those interested in this are said to be San Francisco capitalists.

TRANSPORTATION.

LOS ANGELES, CAL.—The city engineer has approved the plans of the Panama Electric Railway for overhead structures and sheds to be installed over Los Angeles street, at the rear of the company's Sixth street depot.

GLENDALE, CAL.—The board of trustees has granted a franchise to the Pacific Electric Railway for the extension of its line from Glendale avenue eastward to the Child's Tract line and southerly to connect at Tropic with its main line.

RIVERSIDE, CAL.—The Pacific Electric has asked for a franchise across Magnolia avenue just below Myers street at Arlington for the building of a spur track on the southerly side of the avenue to reach the new freight station it proposes to erect there.

SALT LAKE, UTAH.—A franchise asked for by Harry Joseph for the extension of the proposed Jordan-Bingham electric railway through to Midvale has been granted by the county commissioners. The extension as planned is to be from the west side of Jordan River eastward to Midvale.

SAN FRANCISCO, CAL.—The contract for the construction of the Church street Municipal Railway from Sixteenth to Eighteenth and from Twenty-second to Thirtieth streets, has been awarded by the board of public works to the Western Motor Drying Company on its bid of \$57,455. The contract for furnishing trolley poles has been given to John Spargo for \$6590.

FRESNO, CAL.—It is reported that new capital represented by G. O. Whittemore of Los Angeles has been secured for the Fresno interurban railroad project, and that J. B. Rogers has resigned his position as president. Lee H. Landis, who has been traffic manager of the road, has been promoted to the position of general manager. He has interests in other lines, but will now spend most of his time in Fresno. P. N. McCaffrey will continue in his position as superintendent of construction.

SAN FRANCISCO, CAL.—The city engineer has requested the supervisors for an appropriation of \$5000 to enable him to prepare reports on the following proposed Municipal Railway extensions: Potrero avenue line to Hunter's Point, Fifteenth street and Park Hill line, Townsend street line, Sunset District lines and extension of the Stockton street line to Third and Townsend streets. He also intends to report a modified plan for running the Municipal Railway across Golden Gate Park.

WATERWORKS.

POCATELLO, IDAHO.—February 7th is the date set for the hearing on the establishment of a municipal water plant for Pocatello.

GALLUP, N. M.—The city council has taken first steps toward securing an increased water supply. The necessary papers will be drawn up for a bond election for this purpose.

LOVELOCK, NEV.—Lovelock citizens have voted a \$90,000 bond issue to bring water to this place from springs in the Humboldt range of mountains. The Humboldt county board of commissioners will appoint a special committee to locate sources of supply and to install a complete water system.

LOS ANGELES, CAL.—The \$2,604,000 bond issue for the development of the water and irrigation system of San Fernando Valley was passed a second time by the supervisors last week. A feature of action was a request for a bid on only one-third of the total issue, \$868,000. This bid is to be furnished the board not later than February 7th, and each bid is to be accompanied by a certified check for 3 per cent of the total amount. The bonds instead of being dated December 1, 1915, will be dated February 1, 1916. The bidders must offer no less than par, with accrued interest.

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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SAN FRANCISCO, FEBRUARY 5, 1916

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HYDROELECTRIC IRRIGATION IN ARIZONA.
THE SLUMP IN HYDROELECTRIC CONSTRUCTION.

SEMI-DIESEL ENGINES.
BY J. E. MEGSON AND H. S. JONES.

CLOSURE OF COLUMBIA RIVER CHANNEL.
BY L. F. HARZA.

THE CONDENSER POTENTIOMETER IN HIGH
VOLTAGE INVESTIGATIONS.
BY W. D. PEASLEE AND C. E. OAKES.

MATERIALS ADVERTISED IN THIS ISSUE

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Morse Chain Drive Co.

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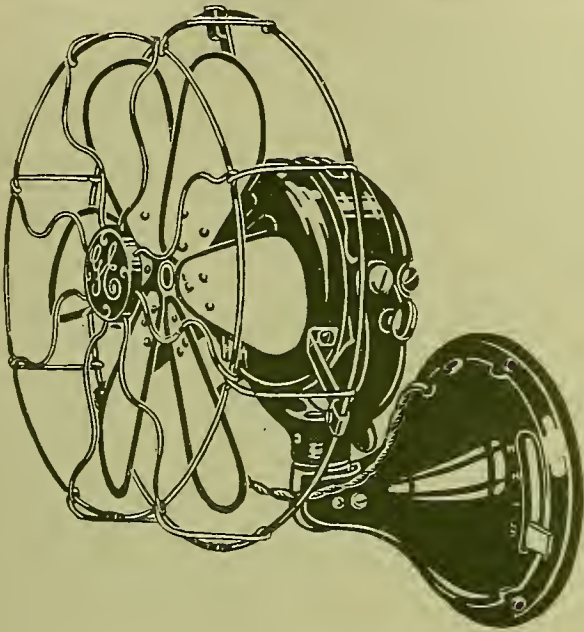
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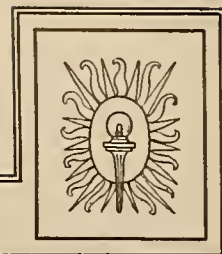
Oil-Burning Engines—No Cinders, No Smudge, No Annoying Smoke. Awarded Grand Prize for Railway Track, Equipment, Motive Power and Safety-First Appliances, San Francisco Exposition, 1915.



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HYDROELECTRIC IRRIGATION IN ARIZONA

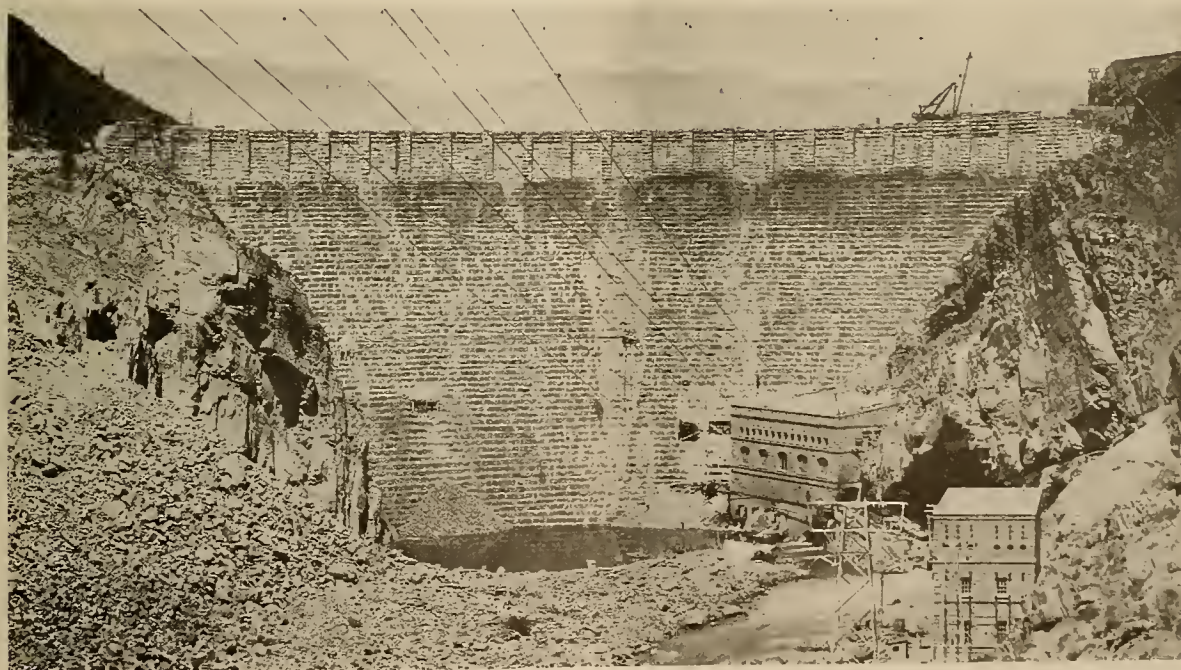
(This discussion on irrigation power supply in Arizona is abstracted from a report on the power situation of the Salt River Project by O. H. Ensign, chief electrical engineer, U. S. Reclamation Service. It contains valuable cost figures and comparisons of hydroelectric, steam, oil and gas power.—The Editor.)

Power on the Salt River Project in Arizona is developed at four hydroelectric plants which feed into a transmission system covering a large portion of the project and transmitting power to supply two large loads at Miami and Superior, the maximum distance of transmission being in the neighborhood of 80 miles.

This power development must be considered as secondary to irrigation, since the latter is the main

valley plants and returned to the river below, but in general the power available follows the irrigation demand, being at a maximum during the summer months and approaching zero during December and January.

Retail light and power distribution involve such an immense amount of detail in the way of accounts, meter reading, lamp renewals, repairs, etc., and re-



Roosevelt Dam and Power House.

purpose of the reclamation project, and where the interests of the power and irrigation are not identical the irrigation interests must control. The interests of power and irrigation do conflict to a large extent, since the plants are dependent for their water supply on irrigation requirements of the project. When no water is required by the farmers no power is available unless stored water is used during such periods for power purposes alone. The situation is relieved to a limited extent at certain brief periods when the flood waters from the Verde can be diverted through the

quires such a highly specialized organization of metermen, solicitors, repair men, bookkeepers and others that the Reclamation Service has avoided entering this field, and has constructed a power system adapted to supplying power in large blocks for individual consumption, or to be re-sold by others. Most of the lines are operated at 10,000 or 40,000 volts, and can not be tapped at an expense which will justify connecting a load, smaller than 100 kilowatts, or more. The expense of tapping the 10,000 volt line would probably not be less than \$250. The 40,000 volt line could

not be tapped for less than \$2000. Each tap is a weak spot, and the more taps there are, the greater are the chances for trouble, and interruptions to service.

A small high-voltage transformer is not a very reliable piece of apparatus, and its insulation is liable to break down and endanger the property or lives of consumers taking power from the secondaries. Good practice demands that pressures not exceeding 4000 volts be used for house to house distribution, on account of less expense involved in making taps and the greater reliability of the lower voltage transformers. The range of transmission with these voltages is, of course, limited, and small consumers must be served in groups receiving power from the high voltage lines at some central point, and transmitting it at low voltage to the individual consumers. The cost of such service is necessarily quite high, and in the present case will probably amount to \$175 per consumer for lines and equipment, and not less than \$45 per year per consumer for maintenance, operation and power. In considering the cost of this power system, it should be borne in mind that the system has been gradually evolved from a small beginning, which was at first intended to supply simply power for the construction of the Roosevelt Dam, and possibly a small amount of pumping; also that the extremely hot climate has necessitated the installation of electrical machinery of a little more generous design than is ordinarily required and consequently has increased somewhat the cost of building these plants. It is equally true, however, that many of the difficulties encountered in the more severe northern climates are not met with on the Salt River Project, and thus the advantage of the hot climate tends to offset in a measure its disadvantages.

The main transmission voltage is 45,000 while the smaller pumping plants and other consumers are supplied from an 11,000 volt secondary net work. The lines are for the most part of steel construction and copper has been made liberal, approximating the economic section which is comparatively large, owing to the high value of power in this vicinity. The lines have been very successful, with the exception of the main transmission line from Roosevelt, which was found to be subject to serious interruptions due to lightning and birds, and has been recently reconstructed, using suspension insulators and two ground wires. Some of the less important lines are run on wooden poles.

Substations.

There is one permanent substation—the Chandler substation, eight miles south of Mesa, which transforms the 45,000 volt current to 11,000 volt current to be delivered to the various pumping stations of this vicinity. This station has an installed transformer capacity of 700 k.v.a. and is built of reinforced concrete. At Phoenix a temporary substation, consisting of a corrugated iron building housing the 700 k.v.a. bank of transformers, has been constructed to supply the local load and at Glendale a similar substation having a capacity of 150 k.v.a. has been installed. Power is delivered to the Pacific Gas & Electric Company at Phoenix at 45,000 volts, and at this voltage the Inspiration Consolidated Copper Company will receive its power at Miami.

Pumping Plants.

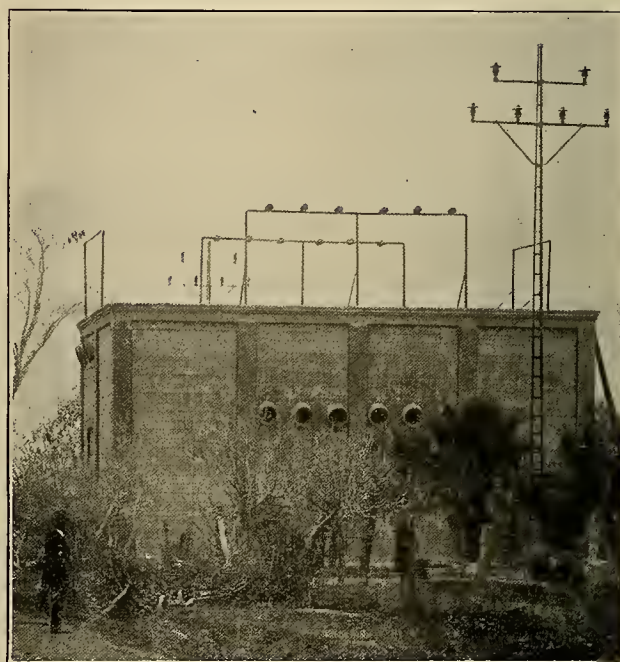
Of these plants all except the Highline plant were built by the Government, the latter having been built by the Highline Canal Construction Company. The cost and capacity of the pumping plants is shown in the following table:

Plant.	Motor H.P.	Discharge.	Cost.
Chandler Wells, 6 batteries..	450	60	\$112,500
San Francisco Well.....	100	7.6	29,000
Clemans Well.....	100	11.65	7,500
Highline	450	60	57,000
McQueen (estimate)	125	15	19,500
			<hr/> \$225,500

First Cost of Power System.

Based on the actual cost of the part of the system completed, and estimates of the construction work in progress, the first cost of the completed system will be as follows:

Roosevelt Power Plant, 12,000 k.v.a.....	\$ 651,000
Roosevelt Power Canal and Dam.....	1,500,000
South Consolidated Power Plant, 2,000 k.v.a.....	162,000
Arizona Falls Power Plant, 1,060 k.v.a.....	109,000
Crosscut Power Plant, 5,250 k.v.a.....	445,000
Crosscut Power Canals.....	255,000
Substations	91,000
Transmission lines	787,000
	<hr/> \$4,000,000



Mesa Switching Station.

Included in these figures is \$1,500,000—the entire cost of the Roosevelt power canal; also \$255,000—representing the cost of the Grand Canal Extension, plus three-fourths the cost of the new Crosscut canal. It is doubtful if these charges against the power system are equitable, since the Roosevelt power canal was built primarily to supply power to the Roosevelt construction plant, and on this basis alone can this construction be considered a paying proposition. At Crosscut—while the new canals were dug primarily for supplying water to the plant, the benefits to the project irrigation system were considerable and a large part of the cost is justly chargeable to the canal system. It was on this basis that the work was first undertaken. Probably \$600,000 to \$800,000 could justly be eliminated from the cost of the power system by a proper adjustment of these charges.

Present Load.

The load connected with the system at the present time consists of ten customers, aside from the Government pumping plants and construction plants. The maximum demand of the present load, and the kilowatt hour consumption of the various consumers during the year 1913, is as follows:

	Maximum Demand kw.	Consumed Power 1913.
Customers	5055	6,472,983
Government uses	1225	1,967,425
Line and transformer losses.....		1,078,162
	6280	9,518,570

Assuming a diversity factor of .8, there is a probability of a maximum simultaneous demand of 5000 kilowatts, which we may be required to furnish at the present time.

During the heavy irrigating months, there is a surplus of power, but during November, December and January, the amount of power available is very small, and for 55 days some stored water or steam power would have been required to carry the assumed 3000 kilowatt load in the Valley.

Cost of Operation.

An estimate of the cost of operating the completed power system is as follows:

	Operation.	Maintenance.	Depreciation.	Superintendence.	Totals.
Roosevelt Power Plant.....	\$15,000	\$13,000	\$26,040	\$1,200	\$55,240
Roosevelt Canal	8,000	5,000	6,000	200	19,200
So. Consolidated Power Plant	5,000	3,300	6,480	800	15,580
Arizona Falls Power Plant	4,500	2,200	4,360	700	11,760
Crosscut Power Plant.....	10,000	8,200	17,800	1,200	37,200
Crosscut Canal	1,000	800	1,020	100	2,920
Substations	3,500	1,000	3,185	600	8,285
Transmission Lines.....	4,500	5,600	31,480	1,200	42,780
	\$51,500	\$39,100	\$96,365	\$6,000	\$192,965
General Expense.....					12,000
Total					\$204,965

The total estimated income from power sales compared with the sales for 1913 is as follows:

	1913 Actual Credits.	Full Operation (Estimated)
Used by Government.....	\$ 18,487.72	\$ 25,000.00
Sold in Valley	111,608.50	150,000.00
Sold to Inspiration.....		386 250.00
	\$130,096.22	\$561,250.00

Based on the foregoing estimates, net results for full operation, and for the year 1913, may be compared as follows:

	1913 Actual.	Full Operation (Estimated)
Operating cost	\$ 87,069.79	\$204,965.00
Credits to power.....	130,096.22	561,250.00
Net credit	43,026.43	356,285.00
Kw.-hr. generated	9,518,570.00	79,000,000.00
Load factor	14%	47%
Cost per kw.-hr.....	0.915c	0.257c

For full operation net credit to power \$356,285 will represent 8.92 per cent per annum on an original investment of \$4,000,000.

Comparison With Other Forms of Powers.

Steam power. Referring to the comparisons between electric power and the use of steam engines, it may be well to analyze the more or less recent improvement in power generating means from fuel available in this locality or elsewhere. Ten years ago it was thought that the economy of power generation had reached a level. Here there were a few isolated plants using expensive superheating methods, which accomplished a very high plant economy, and certain gas engine developments had reached certain high economies under the most advantageous conditions of

test and the right kind of fuel, but these plants could be classed as experimental at that time, or at least, as applicable to only a few special installations. Since that time much experimental work has been carried on, and some very notable advances made along the line of fuel economy. There is no coal available for Salt River Valley that can compare favorably with oil for fuel, so we are confined in this locality to oils, or the distillates therefrom.

Concerning steam power plants—a cross compound plant, having a capacity of from 90 to 200 h.p. with re-heating between high and low pressure cylinder, steam jacketed, high pressure cylinder, and economizers, will produce, when operating continuously at full load, about 2400 indicated horsepower hour per barrel of crude oil. I believe this is about the range of sizes to which we shall be expected to furnish power to large units in the valley, hence this is a fair basis of comparison for the larger power users. This would apply to pumping plants, ice plants, alfalfa mills and other industries of this character where the load is practically constant.

It is a well known fact that steam economy of such a plant would fall off very materially were it operating at lighter loads, and the steam turbine with its flat steam consumption does not come into consideration in plants of this sort. It is only well adapted to electric generation.

The Diesel engine. There have been numerous efforts in this country to burn crude petroleum successfully in moderate sized plants, and in the east on paraffine base oils with Diesel engines, or engines slightly modified from Diesel principles, more or less success has resulted. Unfortunately most of the material appearing in the technical journals has been published in the interest of the manufacturer, and is to be taken as over-optimistic. Very few reliable data are available, as these installations are not very numerous. The Diesel engine has not entered, to any marked degree, the field supplied with asphalt base oils, and the writer's opinion is that it never will on the straight crude oil. There have been a few installations in one or two mines in Arizona, notably in the United Verde mine of Senator Clark's, where an attempt has been made to use the Diesel engine. Such attempts have not been successful using crude oil, and they have been able to run only on stove distillate from 32 down to 23 gravity. This is a dark colored distillate from California crude oil, but is perfectly liquid, and carries no asphaltum. Even on this fuel, the engines have not been eminently successful, as very serious repairs frequently have to be made. In this country we expect a machine to take care of itself, and not receive the intimate attention that is given to power generating units with low labor costs for skilled attendants in Europe, where father and son follow the same vocation, and hence operators can be found who consider such work as their calling. These men are contented with their work, and are usually proficient. Such proficiency is absolutely necessary with a high grade machine as the Diesel engine. The Diesel type engine will have a very small sale among individual farmers, but it will be used more where a large corporation, able to employ expert help makes it practical, or in manufacturing establishments where plenty of skilled labor is

available for repairs. Even then first cost properly accounted for makes the increased economy of doubtful value.

Use of stove distillate. There have been a number of attempts to use the ordinary Otto-cycle engine, on low grade distillates by heating them to a high degree before entering the cylinder. These have been somewhat successful, but repairs are frequent and expensive, and it requires a certain degree of expert knowledge and skill to operate such units. There are some developments, however, under way that promise possible success along this line. There have been installed at Casa Grande a number of units, and one in the Agua Fria country, with an engine of this type. About the Agua Fria plant there is quite a scrap heap consisting of experimental and replaced parts, and the plant as I saw it last was running in a very satisfactory manner. All these types of engines are very expensive, costing from one and one-half to twice as much as a straight distillate engine, and practically equaling a steam plant in cost. In the hands of skillful operators they will show under test between 12 and 16 brake h.p. per gallon, of the heavy distillates, but there are a number of things requiring improvements that make them undesirable and expensive experiments on the part of the user of such units.

Santa Fe tops. The next in line of development is an attempt to burn heavy distillate, or what is known as Santa Fe tops, or Standard gas oil. This material is slightly reddish in color, having a gravity of from 36 to 40, and may be burned in the ordinary so-called gasoline engine with special means for heating or carburation. This material, while not so low in price as the other, is but a fraction higher in Los Angeles than stove distillates which sell for $2\frac{1}{2}c$; and the gas oil sells for $2\frac{3}{4}c$ in quantities. However, it requires on the part of the operator a good deal of attention. In fact, it is sensitive to sudden change of temperature of air, and the engine must be watched through the change from warm daylight to dark night to be sure that it does not stop. So it requires considerable personal attention and labor to take care of it, which barely compensates for the difference between it and the common and well known distillate.

Engine distillates. The next grade of distillate is what is known as Engine No. 1 Distillate, having a gravity of 45 to 50, being comparable to eastern kerosene, except that it is much more explosive and easily handled. This is a fuel that everyone who has operated an engine in the south and west is familiar with, and it is not difficult to so equip an engine with devices for handling the fuel that it may be left with slight attention; usually if a man is within sound of the exhaust he need not necessarily visit the engine more than once or twice in a day of ten hours.

The price of these three fuels—stove distillate, gas oil and engine distillate—in Salt River Valley is 8c a gallon for the first two, and 13c a gallon for the engine distillate. Today there is not working in the Salt River Valley, to my knowledge, more than two or three plants with a lower grade fuel than the engine distillate.

Fixed charges on engine plants. One thing which is often lost sight of by the consumer in discussing his cost of steam or gas engine power, is that his investment is not recoverable, at least only in small

portion, in case he abandons it. Therefore, he must charge a fixed depreciation per annum, the interest on investment and repair bill, although it is customary with gas engines to charge 15 per cent per annum for depreciation and repairs, covering them under this one charge. The manufacturers use that figure themselves, so it at least must be conservative. On the other hand, a gas engine in the hands of any one but skilled experts is liable to sudden and disastrous damage. In fact, any power plant generating power from the use of fuel is subject to this loss, and it is only fair to charge this in as depreciation when counting the cost of power.

Electric rates were based on the known price of fuel in the valley, and from a business standpoint are just and fair. The cost of steam power plant is based on reliable operation of plants of this kind in Southern California, where skilled attendants can be secured at a low figure, and where expert consulting advice is used to keep the plant in good condition, so that the comparison gives the user the benefit of the best kind of operation. The comparisons may be summarized as follows:

100 h.p. Plant (Estimated).

	Load Factor. 100%	Load Factor. 50%
U. S. R. S. rate per brake hp.-hr.	1.61c	2.12c
Simple condensing steam engine oil, \$1.65 per bbl.	1.78	2.30
Compound condensing steam engine oil, \$1.65 per bbl.	1.60	2.14
Simple condensing steam engine oil, \$1.35 per bbl.	1.57	2.04
Compound condensing steam engine oil, \$1.35 per bbl.	1.45	1.94
The present price of crude oil is \$1.65 per bbl., but the expected new freight rate may reduce this to about \$1.35 per bbl. at the plant.		

25 h.p. Plant (Estimated).

U. S. R. S. rate per brake hp.-hr.	2.10c	2.84c
Distillate engine	2.24	2.44
Engine using "Santa Fe Tops"	2.19	2.44

Miscellaneous.

(Actual Cost of Power at Switchboard).

Pacific Gas & Electric Co., Phoenix, 500 kw., load factor 46%, oil \$1.45 per bbl.	1.58c	per hp.-hr.
Pasadena Municipal Plant, 3000 kw., load factor 32%, oil 75c per bbl.	0.985c	" "

The ideal executive is the one who uses his own previous experience in judging and selecting the men who are to assist him, and thus knows that he may turn his mind to bigger things and feel that the details will be carried through correctly. True executive ability lies in getting things done by others more competent to do them.

The Oregon water code has been in operation about six years. During this time approximately one-half the irrigated land of the state has been surveyed, and all rights on many of the largest stream systems have been permanently settled. Perhaps ten years more will suffice to complete this "Doomsday Book" of waters. This work should go on until every existing water right is placed on record, even if the entire expense must be met by general taxation. No other state forces its water users to submit to these adjudications so that the extent of surplus, or public waters, may be known, and at the same time collects such heavy fees as Oregon. The state is equally interested with the water user in knowing the extent of his claim. The title to all water is in the state. Only the right of use is vested in the owner of existing works, and this conditioned on use.—John H. Lewis.

THE SLUMP IN HYDROELECTRIC CONSTRUCTION.

(This statement was submitted by a prominent Eastern engineer (who desires his name withheld) in response to a request from the U. S. Department of the Interior that he give his opinion as to the causes which have brought about the recent falling-off in the amount of hydroelectric power construction. Discussion is invited.—The Editor.)

The fact that there was less hydroelectric construction during 1915 than in years past, I attribute to the competition from steam power and to governmental restrictions to water power development.

Competition from Steam Power.

The great reduction which has been effected in the first cost of steam turbo-generators, the saving which has been made in the steam consumption of such generators per unit of output, the resulting material reduction in the size and first cost of the requisite steam boiler plant, the greater reliability and value of locally generated power, as compared with transmitted power, the acts of public utility regulating commissions, in valuation or rate cases, in penalizing utility companies buying or developing water power, by disallowing the value of their steam station investments; the fact that public utility companies having or buying water power are frequently subjected to rate attacks which would not have developed but for the popular idea that water-generated energy is necessarily the cheapest and should mean very low rates to consumers, whereas, everything considered, most water powers cannot compete successfully with modern steam stations, the persistence of such (frequently unwarranted) demands, especially for low rates and the heavy direct and indirect costs of proving the real facts have caused many public utility concerns to appear indisposed either to develop or to buy hydroelectric power.

No general assertion can be correctly made, that water power is cheaper than steam power or that steam power is cheaper than water power. The relative cheapness of these two sources of power, if freed from any artificial handicaps, depends absolutely upon the local conditions in each case. In some cases fuel is scarce and exceedingly high, and boiler water may be bad and condensing facilities not of the best; in other cases fuel may be exceedingly plentiful, cheap, and of excellent quality, and water conditions for boiler and condensing purposes of the best. In some cases water power in large volume is reliable and can be cheaply constructed; in other cases the reverse is true. Everything else being equal, those who must have power will use either steam or water power, as seems most advisable in their particular case. At the same first cost, the tendency is to use steam power, because water power machinery has already reached nearly 90 per cent efficiency, whereas the first cost of steam machinery is rapidly decreasing and the efficiency rapidly increasing. The developer of steam power, therefore, usually figures that improvements in the art will ultimately cheapen his costs, even though the price of fuel may continue to advance slowly; such advance in the price of fuel has always been less rapid than the progress in efficiency of its utilization.

In the foregoing I have referred to public utility company power consumers because they are among the largest interests concerned and because they represent a thoroughly regulated line of business; also because, to the extent that water power developments are made under state or federal jurisdiction, and operate under franchises, they will probably be similarly regulated eventually. Another reason is because the public utility power companies are gradually but surely securing an ever-increasing percentage of the power business.

I think the falling off in construction may be laid to well-founded apprehensions on the part of investors with respect to some of the above points. They are also realizing that usually the expenditure needed for the initial water power development is considerably beyond that which the immediate market will support, and upon which it can earn interest charges while building up a business, unless those developing the power already command a market and distribution system operated by steam power, the load on which can be turned over to the water power development.

The only way to make developments of water powers attractive is to make them successful and profitable. This requires that they be fully loaded, and this, in turn, usually entails auxiliary steam stations. The selling prices for the power must be kept down to a level which will, on a competitive basis, get all the business within reach.

Government Restrictions.

Any element of cost which adds to the prices at which power is sold curtails the market out of all proportion to such cost item. These prices must pay operating expenses, taxes, fees, depreciation, amortization, and an investment return which is fair and attractive to capital. I believe that it is greatly to the interest of the country at large and of real conservation, that each of these items be kept down as low as possible. Taxes and fees can be minimized by eliminating unnecessary charges by the federal government. Amortization of capital can be practically eliminated by the granting of an indeterminate permit, under commission and court regulation of rates, with a fair purchase or reclamation clause covering the original property and extensions thereof, and a fair minimum term of occupancy, say at least fifty years, in order to give those who venture their capital in the enterprise a chance to develop the possibilities and earnings of the situation.

Most water powers now have a hard enough task to make a good showing against other sources of power, without having added to their difficulties the uncertainties of government by rules and regulations, together with avoidable taxes, fees, or amortization costs. The benefits which would flow from eliminating these cost items would be pronounced, whether measured by the comforts and benefits flowing from a broader utilization of water powers throughout the country or by consideration of fuel conservation.

The most serious present obstacle to obtaining capital at reasonable rates, or at all, for water power development where government land is involved, is the very general belief that water power investors on public lands have been, or will be harshly treated. In-

vestors feel that tenures are unsafe which are governed, not by general laws applying to everybody, but by vitally important rules and regulations (in effect, laws) to be issued by and changed from time to time at the discretion of political appointees of the party which, at the time, happens to be in office. They feel that it is not humanely possible for all these frequently changing officials to have, permanently and consistently, the same views. They feel that so long as tenures depend upon the personal equation or views of the official having the matter in charge for the time being, a variable and shifting policy affecting tenures is certain to follow the changing views of successive officials.

The large amount of capital required for the development of hydroelectric power itself, and the very much larger amount of capital depending upon the stable use of such power, represents, in the aggregate, such a large volume of money, and the investment is of such a permanent and ever-growing character, that investors are unwilling to embark in such enterprises unless their property can be governed by absolutely the same laws as govern all other property. It seems most important that no burdens be put upon government land powers that are not put upon every other power upon private land, whether operated by fuel or water. If there is to be any differentiation of burdens between powers on government land and those on private land, the government can greatly promote the public welfare by providing for the development of public land powers under conditions more favorable to capital than is possible on private land. The really important thing to bring about is true conservation, that is, development and use. This is infinitely more important to the nation than are the few dollars collected under the present system.

I think that any change in the law which will give to the developments on government lands an equal or better chance in competition with developments on private land will be a real constructive measure.

The Detroit conduit ordinance was unanimously turned down by the Detroit common council on December 28, 1915, after a year's investigation. The committee's report stated that "the proposed ordinance was unnecessarily drastic and would increase the cost of electric wiring in Detroit from 50 per cent to 100 per cent without increasing the factor of safety to life and property."

The Alabama condemnation decision of the United States Supreme Court of January 24, 1916, concerning which many have thought that authority might thus be conferred on states to exercise the right of eminent domain as regards Federal lands, does not confirm such hopes. The opinion merely confirms the decision of the Supreme Court of Alabama, that the Alabama Interstate Power Company could not be prohibited from condemning land, water and water rights belonging to the Mt. Vernon-Woodberry Cotton Duck Company, deciding that the purpose of condemnation is a public one. Attorneys who have read the full text of the opinion agree that it does not enlarge the right of eminent domain already existent in the several Western states.

DIESEL ENGINE PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

Semi-Diesels.

In the so-called semi-Diesel the entire cylinder volume of pure air is compressed to from 150 to 300 lb. per sq. in., depending upon the type of engine. A small portion of this air being contained in an auxiliary chamber which is in open communication with the interior of the cylinder and which has been heated to a high temperature, resulting from the mechanical compression, is therefore, considerably hotter in this chamber than in the main portion of the cylinder. The fuel is introduced, at or about the completion of this compression, either directly and entirely into this auxiliary chamber, or through the chamber and partially into the cylinder and gasified and ignited by the heat of compression of the air in the chamber, the combustion taking place more suddenly and with a greater increase in pressure than in the Diesel; and being followed by a more rapid drop.

In both this type of engine and the Diesel type the maximum pressure is approximately the same, though the compression pressure in the semi-Diesel type is considerably lower. Fig. 23 shows typical diagrams of a semi-Diesel engine. The fuel con-

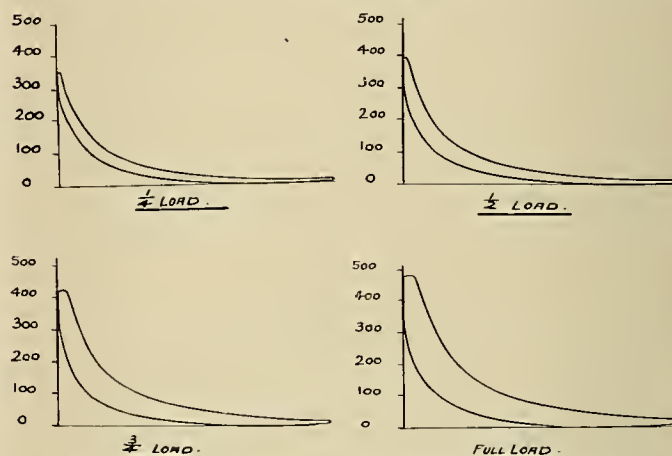


Fig. 23. Typical Semi-Diesel Engine Indicator Cards.

sumption of this type of engine is slightly greater than that guaranteed by the Diesel engine, the full load compression being guaranteed in engines from the size 300 h.p. at .5 lb. of fuel oil at full load, .65 lb. at $\frac{3}{4}$ load and .75 lb. at half load. It will be noted that although the full load consumption corresponds to the Diesel engine that of $\frac{3}{4}$ and $\frac{1}{2}$ loads are considerable higher than those obtained in the true Diesel engine. These semi-Diesel engines are, therefore, economical on steady loads at or near their full load, but do not show nearly the economy of the true Diesel on fluctuating loads. The oil that these engines will use is practically the same as that used in the true Diesel engine and rigid guarantees from responsible manufacturers of this type of engine will completely cover this point.

A cut of a De La Vergne engine is shown in Fig. 24. This engine is horizontal single-acting of the four-stroke-cycle type. "A" representing the inlet valve, "D" the combustion chamber and "B" the exhaust valve. These valves are all operated by rocker arms driven from an eccentric shaft. A two-stage air com-

pressor is supplied to maintain air for starting and spraying the oil. This is driven by an eccentric on the engine shaft. Air from the first stage of the compressor, at 150 lb. is stored in a tank and is available for starting the engine, this pressure being sufficient.

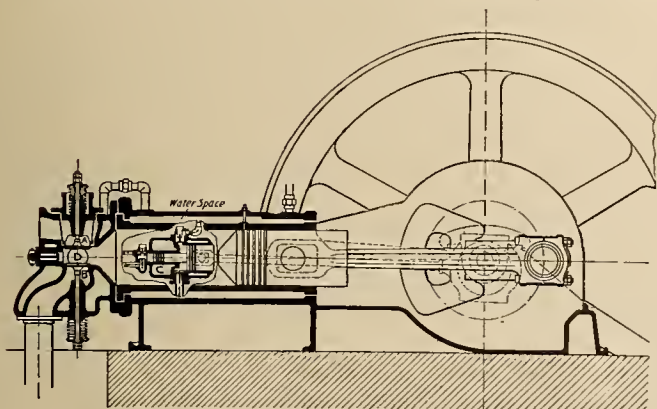


Fig. 24. Longitudinal Section of De La Vergne Engine.

The second stage of the air compressor is quite small in capacity and handles only enough air to spray the oil from stroke to stroke. Speed regulation is guaranteed to be approximately 2 per cent. This company manufactures engines of from 65 to 200 h.p. in single cylinders and from 130 to 400 h.p. in two cylinders and from 200 to 800 h.p. in four cylinders.

A cross section of a semi-Diesel engine manufactured by The Bessemer Gas Engine Company of Erie, Pa., is shown in Fig. 25. This engine is horizontal, using a cross head and is double-acting to the extent that 5 lb. per sq. in. pressure is obtained on the forward stroke of the engine, which is used in filling the cylinders with fresh air and sweeping out the products of combustion on the scavenger stroke. This engine operates on the two-stroke-cycle principle. The hot bulb "D" is a hollow projection which is all that re-

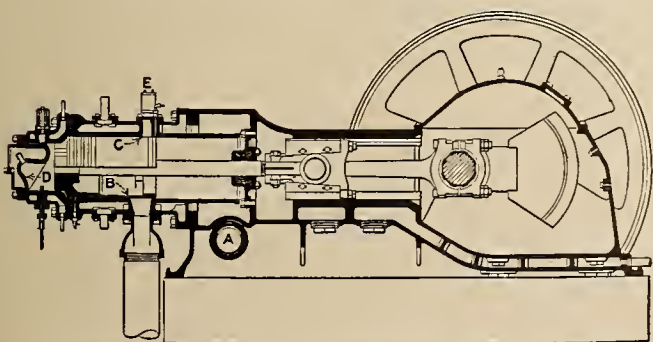


Fig. 25 Section of Bessemer Semi-Diesel Engine

quires heating preparatory to putting the engine into operation. A compression pressure of about 180 lb. per sq. in. pressure is used. The water is delivered to a brass cup "E" by a pump under the control of the governor so that the amount of water injected varies with the fuel used in the same time, but the hand adjustment enables the operator to vary the volume at any time, after which it will still remain proportional. The water flows down into a screened trough and is picked up by the air entering at "C." This is not of the crank case compression type as the stuffing box isolates the crank case from the air pump end of the

cylinder and in this way it is possible to provide automatic lubrication to all bearings. In the larger size of engine oil coolers are provided to reduce the temperature of the lubricating oil before it is returned to the system. The cross head on this engine elimi-

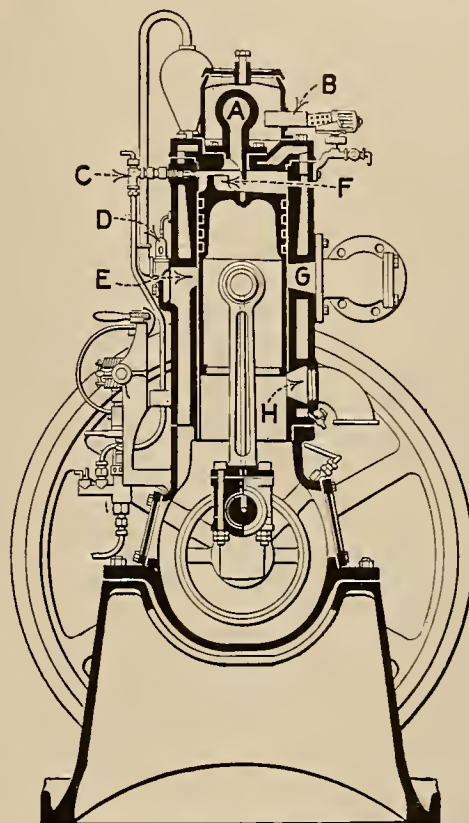


Fig. 26. Metz & Weiss Engine.

nates any side wear on the cylinder. The manufacturer guarantees a fuel economy in engines developing 100 h.p. per cylinder of .65 lb. of fuel oil per brake horsepower hour.

The Mietz & Weiss type of semi-Diesel or heavy oil engine employs steam which is generated from water heated in the jackets for scavenging the cylinder. Fig. 26 shows this engine in section. The bulb "A" is heated by a torch "B" before starting and after the engine is in operation the torch is extinguished and the temperature of the bulb kept by the combustion of the fuel in regular working, which will bring its contents above the ignition point of the fuel at a comparatively low pressure of about 100 lb. per sq. in. The fuel is injected at "C" in quantities measured by the governor which controls the stroke of the feed pump. The incoming air enters the closed crank case through the port "H" when that port is uncovered by the piston on its upward stroke and is compressed after the piston closes the port on the downward stroke at about 3 lb. (gauge), at which pressure it enters the cylinder through the port "E," being deflected upward by the lip "F" and expelling the gases through the exhaust port "G." Vapor from the water jackets is drawn in with it through the pipe "K" and the cock "J" allows enough jacket water to go in with it to prevent pre-ignition. This company manufactures both horizontal and vertical stationary engines and marine engines of the reversible type.

REPORT ON THE COLUMBIA RIVER POWER PROJECT.

Appendix F—Closure of Present River Channel.

BY L. F. HARZA.
(Concluded.)

Concrete dam. As shown in a subsequent chapter under the subject of "Flood Control," it is very desirable that the greatest practicable length of spillway or width of flood channel be secured in order to correspondingly reduce its necessary depth. This has led to considerable study to devise a method of building a concrete dam across which the same flood gate construction as elsewhere could be provided.

Concrete Dam—Plan E. This scheme proposes to close the channel by a large bulkhead or gate built of reinforced concrete or entirely of structural steel. The bulkhead would be virtually a sliding gate of the entire cross-section of the river channel, to be moved into place as a single unit.

The plan suggested, and illustrated in Fig. 31 is as follows:

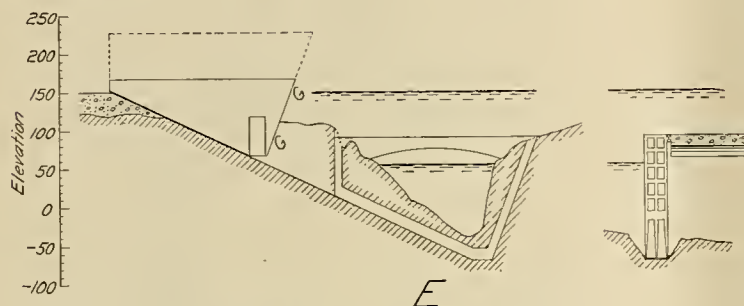


Fig. 31. Suggested Scheme for a Concrete Dam.

A bypass channel on the north side of the river is the first necessary feature under this plan, as well as all other schemes as previously stated. This bypass would have a cross-section area approximating or probably exceeding that of the present river channel at the same elevation. It would be fitted with piers and suitable equipment for effecting a permanent closure after the other works had been completed as a whole and the raising of the head water to its permanent level was possible.

Simultaneously with the construction of the bypass would proceed the erection of a solid concrete arch across the narrows. This arch would be built on steel centering floated into place on pontoons or erected by the cantilever method. It would be of very massive construction, being about 10 ft. thick at the crown and 30 ft. at the abutments; in width the arch would be approximately 100 ft., and in length of span 160 ft. The construction of the arch presents no construction difficulties of unprecedented character.

The arch when completed would serve as one of the bearing surfaces or supports to sustain the pressure of the permanent closing bulkhead. The other bearing surface would be formed in a tunnel built on an incline under the river bed.

Investigations thus far made indicate the rock structure to be a dark, very finely crystalline basalt generally dense in structure and not unusually seamy. It is quite possible that tunneling in this material will

be practically without the use of compressed air. There appears, however, no good reason to doubt that a tunnel and shaft can be excavated entirely under and across the river-bed either with or without the aid of the pneumatic process.

It is proposed to construct in this tunnel a bearing and sliding surface capable of supporting the bulkhead and guiding and retaining it in place, in conjunction with the sliding surface furnished by the upstream face of the concrete arch above described. The bulkhead therefore forms a sliding gate resting on a smooth sliding surface. All sliding and bearing surfaces would be formed by very heavy steel members bedded in concrete to reduce friction and secure good contact. After completion of the tunnel and the sliding and bearing surfaces, the tunnel would be almost filled with sand to protect the completed work and the intervening space between the sand filling and the rock roof would be loaded with explosive. The tunnel roof would then be blasted.

The sliding and bearing ways in the tunnel would be continued in the bottom of a trench on the south side. This trench would constitute the yard in which the bulkhead would be constructed. The bulkhead would be built on ways and then launched like a ship, except that the process would be very gradual and the descent would be controlled and regulated, foot by foot, by appropriate means.

The edge of the bulkhead that first enters the channel (marked G-G in Fig. 31) would be fitted with equipment such as large grab buckets or other suitable apparatus for picking up the rock debris that presumably would encumber the sliding ways. There would probably be in addition, a pneumatic caisson chamber in the bottom of the bulkhead at the point immediately in front of the first point of contact between the bulkhead and the ways, in order to permit removal of any debris that otherwise might impede the passage of the bulkhead.

The friction between the bulkhead, the ways at the bottom and the upper edge of the concrete arch would be overcome by the force of gravity acting on a surface of smooth steel, inclined on a 2 to 1 slope (the slope of the ways). If necessary additional force could be applied in any required amount to secure movement, but it is possible that the only power required would be to retard rather than accelerate movement. The maximum head on the structure would probably not exceed 10 ft. and the aggregate hydrostatic pressure would approximate 10,000 tons. Friction along the upper face of the concrete arch could be materially reduced by a system of roller bearings.

It is expected that the roof of the tunnel would be shot during high water so that the debris would be removed to the largest possible extent by scour during the period of maximum velocity of river.

The bulkhead would be launched and wholly placed during a few weeks of low water when adverse conditions were at a minimum, and would completely divert the river. The dam would be completed by building a secondary dam across the channel, in still water, with the lower face about 200 ft. down-

stream from the upper face of the bulkhead above described, this being accomplished by the use of steel forms or the use of specially molded concrete blocks dovetailing into each other, the foundation course being laid in a pneumatic caisson.

The intervening space between the upper and lower dams would be filled with concrete laid under water, special means being adopted to minimize any tendency of the aggregates to separate. The great mass of concrete filling thus placed would not need to be of a high quality with regard to density or ability to bear tensile stresses. Its chief purpose would be to form a solid platform for the flood channels which would be built on its top surface and to support the heavy piers of the controlling gates.

While it has not been possible to elaborate the details of such a scheme of closure, it is submitted that the general plan offers reasonable expectation of practicability. Details that require elaboration would necessarily call for a high degree of study, special experience and much preliminary experimental work to determine a number of contributing elements about which present knowledge is insufficient, such for instance as the action of a swift bottom current on a pneumatic caisson in particular reference to the entrapment of compressed air by the surging water, the mechanical difficulties in removing the rock debris from the sliding ways in the river channel, and the like.

Concrete dam—Plan F. A vertical shaft would first be sunk on each side of the channel and the lower ends then connected by means of a tunnel under the river bed, arched upstream in plan, as shown

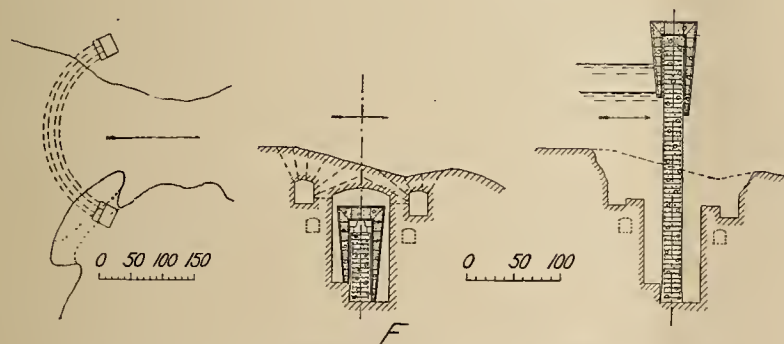


Fig. 32. Another Suggested Scheme for a Concrete Dam.

in Fig. 32. The shafts would then be provided with abutments and skewbacks for an arched dam and this dam would be started in the tunnel under the river. Structurally it would be a steel arch consisting of horizontal curved girders imbedded in and surrounded by concrete. The adoption of steel is to decrease the necessary thickness and hence the required width of the tunnel. There would next be built a pneumatic caisson of inverted U shape along and over the dam as started and sealed at the ends with flexible rubber or metal strips to slide against the completed and smooth skewback surfaces for the purpose of tightness but not to withstand the pressure against the caisson which would be taken by the dam itself. Vertical pipes with air locks would next be built in the shafts entering the caisson at the top. The entire caisson and tunnel would next be filled with some shock absorbing material such as sand or possibly sawdust, after which the roof of the tunnel would be

excavated to a profile as close to the river bed as possible, backfilling the excavation thus made as it progresses upward and providing it, if necessary, with a concrete arch roof for safety. The safe profile of the tunnel roof would be determined in advance as the work progressed, by core borings upward from the tunnel, and the work would be prosecuted under pressure for additional safety. Two small tunnels would be driven, following closely the profile of the main tunnel roof and a few feet away on either side as shown, from which holes would be drilled upward close to the river bed and laterally to the main tunnel. These holes would all be loaded and fired at one time, thus destroying the roof of the main tunnel. The caisson would then be raised by hydraulic jacks resting upon the dam underneath, these jacks being of such capacity and so distributed that alternate jacks could be removed for building up the dam. The load of loose rock on top of the caisson could be raised by it until finally scoured away by the current. When the dam would finally emerge from the water and reach the desired height, the space between the caisson and top of dam, would be concreted, leaving the caisson as the final crest.

This dam has been designed with horizontal curved steel girder-ribs to withstand the entire head of 105 ft. without undue thickness in order to reduce the width of tunnel. It would form a complete dam in itself in lieu of any of the loose-fill schemes shown in Fig. 30. If, however, it were desired to widen the crest to permit the construction of piers for the flood gates as proposed in scheme E, then no steel would be necessary, as the head necessary to divert the river through the diversion channel would probably not exceed 10 ft. at any stage of the river and thereafter the concrete backing would furnish support.

To widen the crest for flood gate piers, there would need to be built a second wall in the form of a reinforced concrete rock filled crib dam, built in still water to fit the bottom or by the method described for Plan E and about 200 or 300 ft. downstream from the concrete arch dam. Between these two dams concrete would be placed under water in bags or by tremies until the desired sill elevation is reached.

For the success of this scheme the removal of the tunnel roof must be complete, as also in the case of scheme E. To insure against possible failure in this respect there are shown by dotted lines two auxiliary tunnels on either side of the main tunnel and below the two small ones from which the blasting was done. These additional tunnels could be driven before the blast or after finding the removal of the roof to be incomplete. From these, holes could be drilled upward and laterally into the main tunnel and the original blast repeated in case the first one should have failed in its purpose.

Experimental study would be needed to determine the stresses to which the caisson would be subjected by the impact of the swift water flowing over it and by the destructive eddy which would undoubtedly form on the downstream side below the crest, before the dam should have emerged from the water. The rate

of progress should be so regulated that the dam would rise from an elevation well below the low water level at the end of one ice season to an elevation high enough to divert the water through the diversion channel before the next ice season.

Comparisons. Without attempting to make any recommendation as to the most preferable scheme of those which have been suggested and considered during this investigation, a few comparisons should nevertheless be made.

The rockfill dam of whatever type makes possible the use of material which must otherwise be wasted and the disposal of which requires a considerable haul. A rockfill dam built in the dry as under usual conditions, with either a puddle or concrete face, is a very common and entirely satisfactory structure when properly built; there is little precedent for its construction in deep, flowing water. The section shown in Figs. 29 and 30 is tentative but is believed to allow amply for buoyancy, which is not usually present, and for the manner in which the fill would be placed. It is intended as a minimum section for estimating rate of progress of work as related to the seasons. In reality rock is a waste product and the channel would subsequently be filled for as great a distance downstream as possible without interfering with the discharge of water from the flood channel, thus making the dam stable beyond criticism, if it is not already so.

The use of the rock-slide method of construction would insure less leakage than the other methods, as the material in the slide could be well graded in size without appreciable disadvantage. It would permit the river to flow undisturbed if desired, up to about one year prior to the completion of the remainder of the project, thus maintaining the headwater at minimum level to the advantage of other construction work such as canal excavation, pier and flood gate construction; in fact the effective flood channel would be much greater than natural, thus lengthening the working season. It is believed that the dam could be built by this method without the use of the diversion channel, as the water would only need to be raised about 17 or 18 ft. to effect a diversion of 100,000 second feet through the main permanent flood channel which would already have been built. The diversion channel is provided in the estimates, however, for all types of dams alike, for purposes of safety and because this channel might be built at all events as a precautionary measure.

The rock slide might considerably shorten the construction period of the entire project, to which extent it offers an advantage over the other methods. In case of its failure, any of the other methods could be resorted to with but little loss of time, as none of the other methods could well be started in any event before the entire completion of the flood channel and its controlling gates. There is some precedent for the use of this or similar method on a smaller scale, notably by the Olympic Power Company in the State of Washington, (*Engineering Record*, March 28, 1914; *Journal of Electricity, Power and Gas*, Oct. 16, 1915).

The second, third and fourth methods all offer the advantage that the work would progress gradually under control within their construction period and

not so much of consequence would be staked upon one single event. The rock for the second and fourth methods and such as used for the third method, could partly be brought directly from the excavation without storing and rehandling, although the dam would necessarily be nearly the last thing to be built, and in this case some favorable excavation would need to be left for this purpose.

The second method offers the advantage of definitely holding material of any desired size which could be predetermined by the size of the mesh, provided, however, that the strains in the chains would be anticipated from previous experiments.

The third and fourth methods are probably the most definite of all in the sense that they involve no unknown strains, as with the second method, nor poorly understood law, as in the case of the rock slide, where the shape of the fill, flatness of slopes and extent of disintegration are at present matters of speculation. Their practicability would depend somewhat upon the necessary size of units as determined by previous experiments, and moreover both the chain bags and the concrete cylinders would be expensive. The fourth method is preferable to the third insofar as it uses a waste material and would conduce to greater tightness. It is believed also that the chain bags would flatten out and interweave, thus binding the whole mass together securely, and possibly permitting the use of steeper slopes and preventing future disintegration from any cause.

The second, third and fourth methods also share an advantage to the extent that the retaining wall and rock pile of the first scheme, might, if greatly increased beyond the height shown, raise a legitimate question as to the ability of the rock foundation to withstand the load imposed, at least without previous preparation by drilling and grouting.

The last three methods also require less space for their construction, which is an advantage when it is considered that part of the area upon which the rock piles would be built would later be excavated.

Of the two plans for concrete dams, the first one has the advantage of simplicity and openness in construction methods. Both have certain advantages not possessed by the other, and in each case the elaboration of any practical plan would call for the exercise of much more study and experimental work than is now practicable. Other plans and modifications of plans have been suggested that contain elements of practicability not necessary to enter into. It is sufficient to state that the possibility of building a solid concrete dam across the channel, while admittedly difficult and even dangerous, offers some prospect of successful accomplishment if adequate financial means are made available.

Conclusions. The study of this problem is not far enough advanced to permit the recommendation of any type of dam nor method of construction. The foregoing description of possible methods of effecting a closure of the river channel should not be construed as definite endorsement of feasibility of every plan herein described; on the contrary, much more exhaustive studies than have been possible hereunder must necessarily precede any final determination.

The schemes proposed for the concrete dam are, however, so novel and elaborate in the detail of their application as to make their adoption inadvisable as a basis of design for dependent works for the purpose of this report. The use of the rockfill built by one of the cruder but probably safer methods has therefore been assumed, and the use of the flood gates of the space occupied by the present river channel has not been depended upon.

It is believed that the study of this problem has been carried to a stage sufficient to establish the feasibility of closing the present river channel by a dam of some permanent and satisfactory character and to permit an approximate estimate of its cost.

Note.—The project engineer feels that due recognition should here be given to others who originated and evolved some of the above schemes, as follows: Scheme B, Fig. 30, E. G. Hopson; scheme C, Fig. 30, O. H. Ensign; scheme E, Fig. 31, E. G. Hopson; scheme F, Fig. 32, O. G. Aichel.

AN ANALYSIS OF OIL GAS TAR.

BY HERBERT E. BRUNKOW.

The recent sudden demand for benzine and other light oils found in coal tar has led men everywhere to develop old sources of supply and discover new ones. One of the most likely products to look to seems to be oil gas tar. The writer having made a series of practical analyses on this tar, endeavors to set forth the methods used and results obtained, in a simple manner, and hopes that contemporary experimenters may profit by this knowledge.

The tar used was a by-product of a gas averaging 570 B.t.u. and therefore generated at a higher temperature than is ordinarily used. The oil from which the gas is made is a California crude with a gravity of about 18.8 deg. Beaume. The tar is pumped from the separator through a series of screens, to a settling tank and from there to a storage tank from which the samples were taken. The specific gravity of the tar at 95 deg. Fahr. is 1.026.

The first process of a logical investigation of a tar is distillation with condensation of the fractions. But in this product a great difficulty was encountered in that the tar would not distill over without frothing or bubbling over. Also naphthalene would clog the condenser tube after heating a very short time.

To overcome the latter difficulty, picric acid was introduced into the still with the tar, to precipitate the naphthalene, but the frothing over still continued; this in spite of the fact that the greatest precautions were used in heating the still. In one instance the temperature in this electrically heated still rose only a few degrees each hour over a period of several days. These facts led to the conclusions that: (1) the tar contained an extraordinary amount of water; (2) the naphthalene deposited so readily because of the absence of solvent light oils.

Several other methods were then tried to determine the amount of water. One of these, the calcium carbide method (Proceedings, Pacific Coast Gas Association, Vol. 8, pp. 458), gave satisfactory results, but necessitated an elaborate apparatus. Another method was distillation under 17 in. vacuum (mercury). This method was successful in that it eliminated to a great extent the condensation of naphthalene in the condenser tube, and also required a lower temperature. Still another method was to place a sample in the

drying oven for twenty-four hours at 212 deg. Fahr. This was not tried until it was certain that no quantity of light oils was present.

The next step was to determine the soluble oils and lampblack. To do this an ordinary Soxhlet extraction apparatus was used with carbon-disulphide as the extracting liquid. After the process was completed the tarred extraction thimble with the lampblack was dried and weighed, as was also the flask containing the oils.

The naphthalene was determined by placing a sample of tar in a silica boat and putting this in a glass tube connected directly to a Drechsel's gas washing bottle, with another bottle in series, and both containing standardized picric acid solution. The last bottle was connected to a filter pump and air drawn through, which, passing over the sample carried the gas naphthalene with it. The tube was gradually heated near the sample so that all the naphthalene might be expelled.

The results obtained were as follows:

	Water.	Method.	Lampblack.	Heavy Oils.	Naphthalene
(1)	64.4%	Cal. Carbide	.....	.....	.....
(2)	65.6%	"	.....	.....	.....
(3)	60.0%	Distillation	8.6%	25.1%	.....
(4)	60.9%	"	.....	.....	.....
(5)	60.7%	Evaporation	10.8%	27.1%	.....
(6)	.....	.....	.....	.....	4.5%

NOTE.—Each number indicates a different sample.

In the distillation a small amount of naphthalene came over with the water, as did also a small amount of light oil—less than .2 per cent—the nature of which was not determined. The lampblack contained a small amount of salt which was also disregarded. The heavy oil, after drying at 212 deg. Fahr. and cooling became hard and was assumed to be asphaltum.

Averaging the above percentages we have:

Water	62.3%
Lampblack	9.7%
Asphaltum	26.1%
Naphthalene	4.5%
Total	101.9%

The conclusions derived from these results are as follows:

(1) The bulk of the water is held in the form of an emulsion. Also the lampblack, which is profuse in the tar, is saturated with water. Both these conditions are causes for frothing over, and so under no ordinary conditions can this product be successfully distilled.

(2) The tar is saturated with naphthalene, as is evidenced when a sample is kept in a container. After a short time crystals deposit on the sides with the slightest cooling.

(3) The only reason the tar can be successfully pumped is because it contains a high percentage of water. This is also a reason why it can be readily burned in a boiler, the water making it easy for the steam to atomize the tar.

(4) The tar is absolutely worthless for the recovery of valuable light oils.

Oil production figures for 1915 show that California ranked first with 89,000,000 barrels, Oklahoma was second with 80,000,000, while Texas, Illinois and Louisiana follow in the order named. The old oil-producing State of Pennsylvania produced nearly 9,000,000 barrels, ranking seventh between West Virginia and Ohio; Wyoming is ninth, and Kansas tenth.

THE CONDENSER POTENTIOMETER IN HIGH VOLTAGE INVESTIGATIONS.

BY W. D. PEASLEE AND C. E. OAKES.

(Apparatus for measuring the effect of high frequency current on insulators is herein described, together with results obtained. Mr. Peaslee is a consulting engineer at Portland and connected with the electrical engineering department of the Oregon Agricultural College. Mr. Oakes is assistant instructor in electrical engineering at the college.—The Editor.)

In the course of some recent investigations on the effect of arcing grounds on a transmission line it became necessary to develop a device to measure, by means of a spark gap, the dielectric stress on an insulator string when under the influence of combined sixty cycle and high frequency pressures without the formation of a power arc in parallel with the insulator string or changing the constants of the oscillating circuit to an appreciable extent.

The above limitations necessitated the use of a device which would give a definite and stable increment of the total stress up to a point of breakdown of the gap, and which would not change appreciably the capacitance of the circuit when the gap broke down. The work of Prof. Ryan in determining the distribution of the stresses on the surface of an insulator, in which he employed a multi-section condenser to secure definite fractions of the total oper-

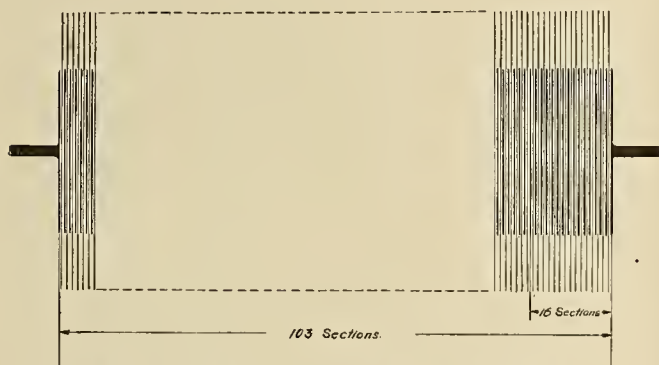


Fig. 1. Diagram of Condenser Potentiometer.

ating voltage, led the authors to an investigation of this method for these particular conditions.

The oscillating section of the line under investigation had a capacitance of 78.76×10^{-5} mf., and an inductance of 7.103×10^{-5} henrys, which with lumped inductance and capacitance gave a natural frequency of 847,550 cycles per second.

A condenser was built up of 103 sections in series as shown in Fig. 1, each section consisting of thin metal plates 6 cm. x 5 cm. with a glass plate .1296 cm. thick between the plates, the whole clamped firmly together and immersed in oil. The capacitance of these sections in series was $.119 \times 10^{-5}$ mf. and the frequency with this condenser added to the line was 846,900 cycles per second. The spark gap was placed across 16 end sections of this condenser and on breakdown of the gap short-circuiting these sections the capacitance of the remaining 87 sections in series was $.1414 \times 10^{-5}$ mf., giving a change in capacitance of $.0224 \times 10^{-5}$ mf. in a circuit containing 78.88×10^{-5} mf. Obviously the change caused by the breakdown of the gap across these 16 sections does not change the

conditions of the circuit within the degree of accuracy obtainable in such experimental work.

This equipment was then calibrated on sixty cycles by measuring the high tension voltage on the low side of the supply transformer and determining for various voltages the needle gap break-down across the 16 sections. The results of three such determinations, reduced to standard conditions of barometer and temperature are shown in Fig. 2.

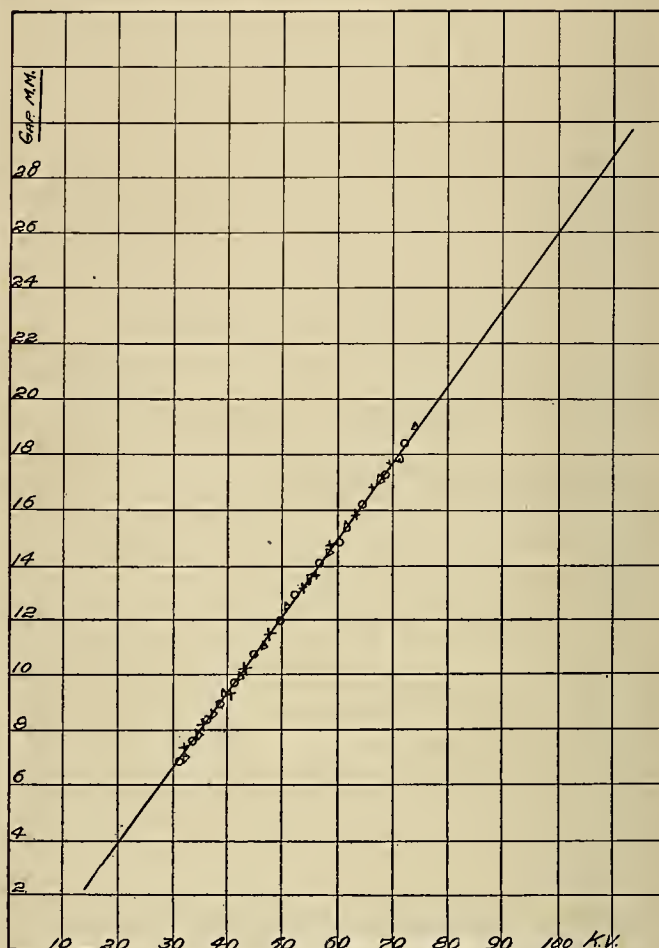


Fig. 2. Calibration of Condenser Potentiometer.
Kilovolts vs. Needle Gap across 16 Sections.

This calibration will not be correct for high frequency voltages as, due to the dielectric spark lag, the needle gap at high frequency indicates a lower voltage than is actually impressed, especially when the oscillations are in the form of rather highly damped trains. The error however will be an indication of a lesser stress than that actually put upon the apparatus.

The condenser must be supported in the oil on hard wood blocks boiled in oil and the whole device must be carefully guarded from stray electro-static fields and leakage.

As an illustration of the results secured with this device the curves in Fig. 3 showing the data on an experimental line may be of interest. Curve No. 1 is the stress in volts on an insulator string connected across the line when under the influence of arcing grounds. This stress is a superposition of the normal frequency voltage of the line and the high frequency voltage due to the oscillations set up by the arcing grounds, and as discussed before, the actual maximum stress is greater than indicated as far as the increment

due to the high frequency voltage is concerned. These curves are plotted showing voltage stress across the insulator string as a function of the effective current in the oscillating section of the line as measured with a hot-wire ammeter.

Curve No. 2 is the increment of the total stress due to the sixty cycle voltage impressed on the insulator string as read by a volt meter in the low tension side of the supply transformer.

Curve No. 3, the difference between these curves (No. 1 and No. 2) then shows the extra stress due

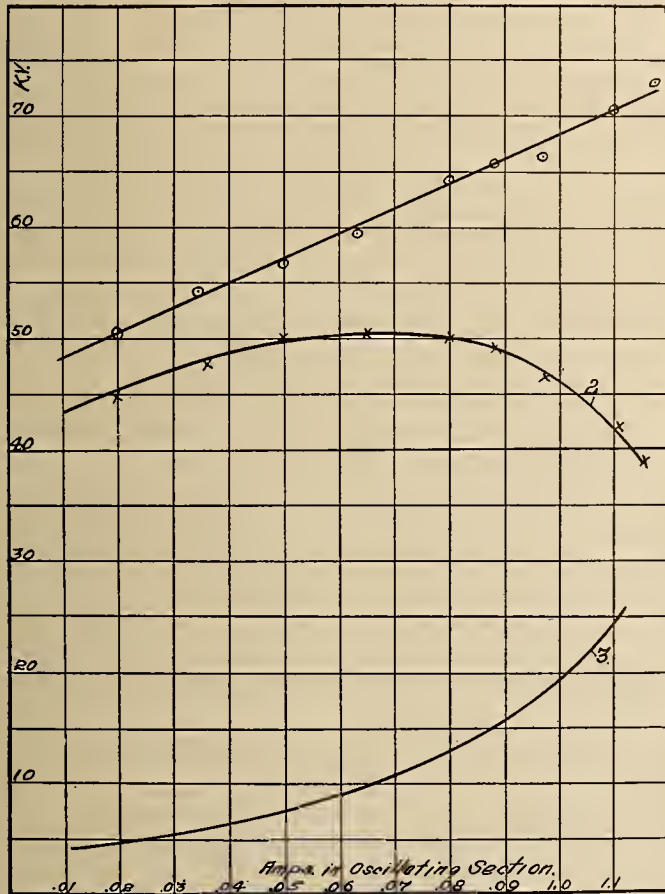


Fig. 3. Potential Stress Due to Normal and High Frequency on Line under Influence of Arcing Grounds.

to the high frequency oscillations set up by the arcing ground. As before noted the actual maximum stress is greater than is indicated by this curve.

The data in these curves are not offered as quantitative but is some taken in the course of a preliminary investigation undertaken to prepare for the more searching work now to be taken up with the aid of a newly acquired cathode tube cyclograph.

The importance of an accurate knowledge of the voltage stresses imposed by the high frequency oscillations set up in a transmission line under various conditions of operation is rapidly being recognized by all engaged in the transmission of power at high voltages and with the advantages of a cathode tube now available the authors hope at an early date to be able to publish some interesting data on these phenomena.

The capacity of a motor increases, in general, in the same proportion as the speed increases, but decreases faster than the speed when the speed is being reduced because of the corresponding reduction in ventilation.

RIVER SURVEYS IN WASHINGTON AND OREGON.

The United States Geological Survey has just issued, as Water Supply Paper 377, the results of river surveys made in Spokane River basin, Washington, and John Day River basin, Oregon, to determine the location of undeveloped water powers on the rivers. The ten profile sheets included in the report show the outlines of the river banks and other physical features to an elevation high enough to indicate the possibility of using the streams as sources of power.

Spokane River rises in western Idaho, and, flowing west and northwest, discharges into Columbia River near Fort Spokane, Wash. Most of the lands along Spokane River are agricultural and the high lands flanking the canyon of the river are used extensively for raising wheat. The Spokane affords a large amount of power. The highest spillway dam in existence is erected on this river, about 24 miles northwest of the city of Spokane. Already 57,000 horsepower has been developed on the river and two additional plants are projected, at each of which 20,000 horsepower can be developed.

John Day River, Oregon, drains about 7800 square miles northwest of the Blue Mountains. The head-water region of the stream is forested. Except wheat, which is grown on the rolling uplands by "dry farming," no important agricultural products can be raised without irrigation, of which there is very little, because the areas admitting of easy irrigation are confined to the immediate valleys of the streams. Storage facilities are ample for the several projects under which large areas of productive table-lands would be developed by storage reservoirs and high line canals.

Joint pole construction is now employed at Portland, Ore., by the Portland Railway, Light & Power Company, the Northwestern Electric Company, the Pacific Telephone & Telegraph Company and the Home Telephone Company; 3071 telephone and power wire poles are now controlled jointly by the four companies.

The electric steel industry of the world has more than doubled in the last 2½ years, increasing from 140 to 303 furnaces. The United States has 73 furnaces, Germany 53, England 46, Sweden 23, and Canada 8. Of those in the United States, 40 are Heroult furnaces, with a yearly rated production of 1,470,350 tons; 12 are Snyder furnaces, with an average 24-hr. production of 13 tons each, and 6 are Wile, with an average daily capacity of 12 tons.

Spark ignition of explosive gas mixtures depends not only upon the heat produced by the spark but also upon the amount of ionization it causes. In a paper on this subject recently read before the British Institution of Electrical Engineers J. D. Morgan showed that the frequency of the spark and the inductance of the circuit were important factors in determining the "incendivity" of a spark. He suggests that six volts should be the highest permissible voltage of bell circuits in mines where explosive gases existed. This study also has a bearing on gas engine ignition.

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To speak of a slump in hydroelectric construction in the West, where more than a third of the nation's water power has already been developed for the use of but six per cent of the national population, seems paradoxical. But when it is considered that more than half of the available water power in the United States lies west of the Rocky Mountains there is seen to be immediate need of conserving this power by the wise utilization of water that is now running idly to the sea. Irreplaceable fuel is being consumed to do what should be done by self-renewing water power.

The limited amount of new developments during 1915 and the meager prospects for new construction during 1916 are made strikingly evident in comparison with the tremendous activity of the preceding ten years. Whereas a capacity of two hundred thousand kilowatts in hydroelectric power were developed in the West between 1894 and 1904, four times as much, or 800,000 kilowatts, were developed in the 1904-1914 period, giving more than one million kilowatts capacity installed during the twenty-year time.

A number of reasons have been assigned for the marked falling off in construction during the last two years. Forest Service officials claim that the supply exceeds the demand. While this may be true in a few localities in the northwest where unregulated municipal competition exists or where one company has cut into the field of another, it is not generally true on the Pacific Coast. Two reasons more universally applicable are given in an article on this subject appearing elsewhere in these columns—competition from steam power and governmental restrictions to waterpower development.

Ultimate analysis will show that most of the hindrances to hydroelectric construction originate in the mistaken idea that water power is cheap. This idea is a relic of the time when steam power was expensive. In the twenty years that have witnessed such phenomenal water power development in the West, only slight improvement in efficiency of utilization has been possible because the limits of possible efficiency had already been closely approached. But, during the same period, steam apparatus has been vastly improved and still has great room for increased efficiency. The average cost of the large hydroelectric development and transmission in the West is close to two hundred dollars per horsepower of installed capacity, whereas steam-electric plants are being installed for considerably less than half this amount.

Unfortunately the impression of the cheapness of water power still persists in the minds of people clamoring for lower rates and in government officials seeking new sources of taxation. This sentiment reacts on investors who hesitate to entrust their funds in any project subject to the vagaries of such governmental restrictions and thus retards developments which would be possible if permits could be obtained.

Notwithstanding the high cost of hydroelectric transmission systems there are many sites where

small powers could be economically developed for industrial purposes. Thus cheap power could be furnished for railroads, manufacturing and irrigation and the more rapid development of the territory brought about. To this end it is desirable that enlightened legislation be passed by Congress so that men will be encouraged in the beneficial utilization of wasting resources, instead of being discouraged as at present.

Aside from the jocular definitions of an engineer as a man out of a job most attempts to define an engineer have been confined to a statement of his duties. Consequently the quantitative summation of those attributes that constitute a successful engineer, which has been compiled by the American Society of Civil Engineers' committee on engineering education, is at once novel and interesting. As it represents the composite opinion of fifteen hundred practicing engineers as to what are the essentials of a successful engineer this rating also carries a certain measure of authority. The yard-stick for sizing up an engineer follows:

1. Character, including integrity, responsibility, resourcefulness, initiative41.0
2. Judgment, including common sense, scientific attitude, perspective17.5
3. Efficiency, including thoroughness, accuracy, industry14.5
4. Understanding of men, executive ability.....14.0
—87.0
5. Knowledge of the fundamentals of engineering science 7.0
6. Technique of practice and of business..... 6.0
—13.0

The most noticeable feature of this rating is the low value of 13 per cent assigned to technical ability. Less than half of this, even, is credited to specialized technique. It is very evident that success in engineering, as in other walks of life, is measured not by what a man knows, but what he does with what he knows.

The factors in accomplishment, the doing of things, are character, judgment, efficiency and understanding of men, the same factors that govern success in any business. Any man characterized by these attributes would be successful in any field with whose rudiments he was familiar. Technical knowledge, whether of medicine, law, business, or what not, is secondary to the measure of the man.

The purpose in thus classifying those qualities which make up a successful engineer was to give guidance to the technical schools regarding the finished product desired. It has been pointed out that if technical ability is only about one-eighth of a man's capability, technical education should be radically changed.

In this respect technical schools seem to take themselves too seriously and the professors therein have a commendable tendency to assume too much responsibility for the type of men they graduate. Entirely too much credit is given to the four years of college life in distinguishing whether a man is an engineer or not. This question frequently arises in

passing upon applicants for membership in engineers' clubs, where a technical training is given greater weight than later achievements.

Few men come under the category of successful engineers before they are thirty-two years of age. Only one-eighth of this time was spent in college, presumably in the acquisition of technical training, which is given a rating of one-eighth in defining an engineer. Seven-eighths of the time is available for qualifying under the other requirements which are given a seven-eighths rating. Of course a college education should build character, impart judgment, promote efficiency and bring an understanding of men, just as much technical ability is acquired after graduation, but to attempt to crowd all these things into a four year's course is to attempt the impossible.

Character is merely a by-product of doing the nearest duty well, judgment comes from experience and involves a modicum of age; efficiency should be cultivated at all times, and understanding of men comes only after man's age has been reached. This does not imply that by the mere addition of age to a man he can "manage" better, but it does show that the period from eighteen to twenty-two years of age is not the only period which brings about the development of successful engineers.

We read in the old Arabian mythology that Satan and his wife Awwa had nine sons who brought all sorts of evil to mankind. Least powerful of this progeny was Lakis, the fire fiend. For in that ancient day his power was limited to such acts of mischief as killing a man with a bolt of lightning or burning a hut by upsetting a lamp.

In the course of time, however, Lakis, or Loki, as the Norsemen called him, and the Latin's Lux, came to be esteemed the greatest instead of the least of the sons of Satan. He inspired the discovery of gunpowder, which soon passed from an innocent noisemaking toy to a death-dealing device. He caused the invention of matches, "lucifers," which put into the hands of every evil-minded man or silly child the power to burn a house, a barn, or even a city. Great was the havoc he wrought.

Yet some of the sons of Eve did eat of the fruit of the trees of knowledge which had sprouted from seeds carried out of the Garden of Eden. They learned that the powers of evil could be restrained and put to work as the servants of man. They confined the fire so that it could be used to heat and cook. Gunpowder was used for blasting stumps and driving tunnels and winning metals from the earth. Electricity was made the slave of the lamp, giving light whenever man so willed, letting him talk across oceans and continents and transporting him and his goods over land and sea.

Nor is the end yet in sight if man will but continue to learn from experience how to subdue the forces of Nature. There is no evil but that can be converted into some good. Proper knowledge will force the genii into a bottle or harness him so that his energies may be turned to the service of men.

What is an Engineer?

The Power of Knowledge

PERSONALS

Wm. Werner, of the Nevada Machinery & Electric Company, of Reno, Nevada, is at San Francisco.

W. J. Barker, vice-president and general manager of the Denver Gas & Electric Light Company, is at San Francisco.

C. R. Hunt, Pacific Coast manager of the Robbins-Myers Company, is making an extended business trip throughout the Southwest.

B. J. Klein, Western manager of the Bristol Company, has returned from an extended business trip throughout the San Joaquin Valley.

D. R. Bullen, general sales manager of the General Electric Company of Schenectady, recently arrived at Los Angeles on a brief business visit to the Coast.

N. K. Cooper, mining salesman of the Westinghouse Electric & Manufacturing Company, has returned to San Francisco from an extended trip throughout Nevada.

W. B. McDonald, manager of the Northern Idaho & Montana Power Company, Kalispell, Montana division, was recently elected a director of the Kalispell Chamber of Commerce.

Attila Norman, general manager of the Oregon Power Company, has been appointed official delegate of the Eugene Commercial Club to the Chamber of Commerce of the United States.

W. L. Goodwin, vice-president and general manager of the Pacific States Electric Company, has returned to San Francisco after spending the past four weeks in the northern territory.

L. B. Loomis, of the transmission tower department of the Milliken Bros. Iron Works, of Staten Island, N. Y., has returned East after an extended trip throughout the Pacific Coast States.

L. A. Somers, sales engineer with the Westinghouse Electric & Manufacturing Company at San Francisco, has recently returned from an extended trip throughout the California oil fields.

R. H. Ballard, secretary and assistant general manager of the Southern California Edison Company, has received the distinctive honor of election as a member of the Franklin Institute of the State of Pennsylvania.

H. W. Cope, who has been for the past year in charge of the Westinghouse Electric & Manufacturing Company's exhibit at the P. P. I. E., has left for San Diego, where he will stop for a week or ten days before returning East.

W. F. Sheppard has resigned from the engineering sales department of the General Electric Company at San Francisco to become commercial agent for the California-Oregon Power Company at Yreka, Cal.

H. D. Shute, treasurer, and **J. J. Jackson**, general attorney of the Westinghouse Electric & Manufacturing Company, who recently arrived on the Coast from East Pittsburgh, left for Los Angeles this week on their return home.

Sidney B. Cooper, electric railway division engineer with the Westinghouse Electric & Manufacturing Company, for the past year stationed at the P. P. I. E., and **Frank P. Harrison**, of the industrial staff, have just returned to East Pittsburgh.

C. N. Masson, illuminating engineer with the Southern Company Edison Company at Los Angeles, and **F. C. Piatt**, with the Pacific Gas & Electric Company at San Francisco have been appointed members of the committee on municipal and highway lighting of the Lighting Sales Bureau of the N. E. L. A. Commercial Section.

O. B. Coldwell, general superintendent of the Portland, Railway, Light & Power Company, has been elected president of the Brotherhood of Electric Railway Employees. In his

inaugural address, Mr. Coldwell discussed the development of electric railways in this country and the history of the Portland company and its antecedents.

Francis H. Murphy, illuminating engineer with the Portland Railway, Light & Power Company, has been appointed a member of the advertising signs committee, the committee on the lighting of stores and public buildings, the committee on municipal and highway lighting and the committee on residence lighting of the Lighting Sales Bureau of the commercial section of the National Electric Light Association.

Paul Sutcliffe has been appointed advertising manager of the Edison Storage Battery Company, Orange, N. J. Mr. Sutcliffe got his earlier advertising and selling experience in California. On going east in 1912 he joined the Edison interests but resigned at the end of a year to become secretary of the W. S. Hill Advertising Company, Pittsburg, Pa. He has been in the advertising department of the Edison Storage Battery Company for the past year.

F. H. Thompson, who has been connected with the Westinghouse Electric & Mfg. Company, for 27 years, 15 years as their foreign construction man, and 12 years representing them in the Philippine Islands, with **J. H. Grainger**, formerly construction engineer of the Allis-Chalmers Company, and **Arthur T. Riggs**, formerly connected with the Robbins-Myers Company, have recently incorporated under the name of The Appliance Manufacturing Company at San Francisco. This company has started the manufacture of an automatic priming device and fuel heater, which permits the burning of distillate in all internal combustion gas engines.

MEETING NOTICES.

Los Angeles Jovian League.

Nearly 150 Jovians assembled at the regular weekly luncheon, Wednesday, January 26th, to enjoy an elaborate program arranged for them by E. C. Ebert, vice-president of the Beacon Light Company, chairman of the day. President Holland, with his customary snap and vim, directed operations with alacrity and dispatch, crowding a full afternoon's entertainment into an hour. Several prominent visitors were introduced, among them A. K. Baylor, from New York City, a general officer of the General Electric Company. J. G. Pomeroy, maintaining that he recognized only members with badges, introduced several prominent Jovians as visitors. They were promptly fined, and fines were collected by City Electrician Manahan, at the point of a big six-shooter. Miss Southwick, one of the department heads of the Y. W. C. A., in an interesting talk, "The Social Service Power Plant," outlined the commendable work of the Social Service Bureau of the Association, stating that employment was provided for 2574 young girls in Los Angeles, last year by the Association. The speaker of the day, Rev. Chas. C. Selecman, pastor of Trinity Auditorium, spoke on "The Conversion of Jove." In a highly entertaining and amusing manner, he described how Jove, the mythological God of somewhat questionable reputation, was transformed or "converted" and now rules and guides the Universe with the power of his magic force, "Electricity." Vocal and instrumental numbers of unusual merit completed an excellent and well-balanced program.

Rocky Mountain Association of Municipal Electricians.

The Rocky Mountain Association of Municipal Electricians, including the states of Colorado, Wyoming, New Mexico and Utah, held their annual convention at the Albany Hotel, Denver, Colorado, on January 20th and 21st, which was largely attended. President C. L. Reasoner, city electrician at Colorado Springs, presided during the early part of the meeting, but was called out of town, and Mr. David Reed, superintendent of the Denver Alarm Telegraph System, was appointed chairman pro tem.

The meeting was opened by an address of welcome by Fire Chief Healy of the Denver fire department, and after the

ordinary business the session closed with a general discussion of standard electrical material and appliances.

Thursday afternoon there was a large question box in which a number of important questions regarding municipal wiring were discussed. The Thursday evening session consisted of a banquet at the Albany Hotel, and a party at the Denver Athletic Club, to witness a prize fight.

Friday, January 21st, B. C. J. Wheatlake of the General Electric Company, read a paper on Wire and Wiring Appliances, which aroused a large amount of discussion among the members, particularly in reference to the new code wiring. In the afternoon an inspection trip was made to the Denver Gas & Electric Light Company's power house, and in the evening the members attending were presented with tickets to the National Stock Show, then being held in Denver.

The meeting closed with the election of the following officers: President, Lawrence Stone, city electrician of Denver; 1st vice-president, David Reed, superintendent of telegraph, Denver; 2d vice-president, G. L. Smith, city electrician, Fort Collins; secretary-treasurer, L. A. Varley, Rocky Mountain Fire Underwriters' Association.

Electrical Development and Jovian League.

The January 26th meeting was given over to the question of "National Preparedness," Frank J. Symmes, an ex-U. S. Naval Officer, being speaker and introduced by F. H. Thrall, acting as chairman of the day. Mr. Symmes, who is an active worker in the Navy League, said in part: "The preparedness which the Navy League advocates is a strong navy and that we realize, as we do, that while the ordinary conditions are sufficient when protected by ordinary provisions for carrying them out, there are times when the emergency happens. The arguments for the preservation of our nation are such that no good sensible men or people can afford to trust their charges as they are trusting them now with our military preparation. It is said that the great nations now fighting will so-exhaust themselves that when the present war is over there will be no further fighting, but we know further that the conditions of international agreements are such that when the time comes and there is a necessity to break a policy or agreement there is no hesitancy about breaking that agreement, all the conferences and all the treaties as we now see have failed. While we advocate treaties and conferences we cannot trust these in the light of what has occurred. The emergency may come and we would be very unwise if we were not prepared for war. At this time we are least prepared than at any time in the history of our country."

At the conclusion of his talk Mr. Symmes introduced his guest, Col. Thompson, also a member of the Navy League, who also presented some interesting facts and figures on an increased navy, stating that \$500,000,000 should be expended to put the navy of the U. S. in the fore rank of nations, instead of the fifth place as at present. The luncheon was interspersed with most enjoyable vocal and instrumental numbers. Over 80 members were present. At the conclusion a hearty vote of thanks was given the speakers and the chairman of the day.

ELECTRICAL CONTRACTS, PORTLAND, OREGON.

Pierce-Tomilson Company are remodeling and adding to the electrical installation in the Meus Cafe.

Walker Electric Works are installing the electric motors in the Pacific Waste Company's plant.

Miller & Halls are installing the new lighting system in the store at 132 Fifth street to be occupied by J. Byron.

Robert Skeen Electric Works are doing a \$1000 worth of work for the Realty Association, 361 Washington street.

Western Electric Works are installing a new switchboard in the Pickford Theatre.

Pierce-Tomilson Electric Company installed all of the wiring in connection with the automobile show being held in the armory.

Western Electric Works remodeled the wiring for the new Morris Cafeteria on Fifth street.

West Coast Engineering Company are remodeling the wiring on the first floor of the Lumbermen's Building.

Miller & Halls have completed the overhauling and extension of the lighting and power system in the Oregon Chair Company's plant; also the remodeling of the lighting system in the Yeon Building for the new addition to the Woolworth 5, 10 and 15c store.

M. J. Walsh & Company have just completed the installation of a new switchboard for the Portland Woolen Mills at St. Johns.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Pacific Gas & Electric Company has applied to the commission for authority to capitalize that part of its net earnings or surplus profits which it has applied in 1914 and 1915 to the reduction of its bonded indebtedness through payments into sinking funds, and the reduction of outstanding bonds, and also the sum from the same sources which it intends to apply in 1916 to the same purposes. The company wants permission to issue to common capital stockholders, as a common stock dividend, as many shares of its unissued common capital stock, as at par or face value shall equal this capitalization. The amount is not to exceed three per cent of the outstanding common capital stock, or not more than 10,211 shares. The retirements in 1914 and 1915 to be capitalized amount to \$449,500, and in 1916 to \$762,015.63.

The Northern California Power Company Consolidated, has filed with the commission, an application for authority to enter into an agreement for the extension of time until February 1, 1920, for the payment of outstanding debentures aggregating \$670,000. The original issue was \$860,500 of six per cent gold bonds, dated February 1, 1912, and due February 1, 1915. Of these bonds, \$190,500 have been paid and cancelled. The agreement is with Mortimer Fleischacker and others, and Sacramento Valley Power Company, holders of bonds.

The Empire Telephone Company of Empire, Stanislaus county, has filed with the commission an application for authority to issue a certificate of common stock at a par value of \$35 to each of 38 persons who have paid the corporation that sum. The money is for construction.

The commission has issued an order authorizing the Santa Paula Home Telephone Company to buy the property of the Pacific Telephone & Telegraph Company in Santa Paula, Ventura county, for \$25,000 and to issue to the latter company its two-year note for this sum at 6 per cent.

The Oro Electric Corporation has filed with the commission an account of bonds pledged of the value of \$135,000 under the authority of the commission for a total of \$180,000. Of the bonds there were redeemed and returned to the treasury \$135,000, leaving \$45,000 still pledged.

TRADE NOTES.

The completion of the Willamette Pacific branch of the Southern Pacific Railroad between Eugene and Coos Bay, Oregon, a distance of 221 miles, opens up a rich territory where coal mining, fishing, timbering, dairying, stock raising, fruit raising and agriculture will supply the major part of the new road's tonnage.

The contract for 2000 h.p. in motors for the Crossett Western Lumber Company at Wauna, Wash., was awarded to the Allis-Chalmers Manufacturing Company through the Portland office and not to the Westinghouse as previously announced in connection with the contract for a 1875 k.v.a. Westinghouse steam turbine and Le Blanc condenser.



NEWS NOTES



ILLUMINATION.

LOS ANGELES, CAL.—The board of supervisors has adopted specifications for additional lights in the Sheran District.

SPOKANE, WASH.—Commissioner Fassett has instructed the city engineer's office to proceed with plans and estimates for the lighting of Sprague avenue.

CASA GRANDE, ARIZ.—The town council has called a bond election for February 15th. The proposition includes an issue of \$21,000 for a lighting plant.

REDLANDS, CAL.—The Southern California Edison Company will install a new type of arc light in place of lights now in use. The lights will be installed at once.

PHOENIX, ARIZ.—The county board of supervisors has granted a franchise to the city of Glendale to extend its present light and water plant outside of the city limits.

LOYALTON, CAL.—An ordinance has been passed providing for the issuance and redemption of bonds in the sum of \$5000 for the construction of an electric light and power plant.

BERKELEY, CAL.—A contract for the installation of a new lighting system in Lighting District No. 1, has been awarded to the Pacific Fire Extinguisher Company on its bid of \$22,300.

SPOKANE, WASH.—F. H. Shields, head of the Shields Investment Company, has purchased the controlling interest in the Rathdrum Electric Company, which supplies light to the towns of Post Falls and Rathdrum, Idaho.

HUNTINGTON BEACH, CAL.—At a meeting of the board of supervisors bids were received for additional lights for the Tustin Lighting District, and the bid of the Southern California Edison Company of \$1.15 per 32 candle power was accepted.

PHOENIX, ARIZ.—The city commission has awarded a contract for the installation of additional ornamental street lights to the New State Electric Supply & Fixture Company at \$18,550. The city will furnish standards and the contractors all the material and labor.

WOODLAND, CAL.—At a conference held here Local Manager Coons and Engineer Jones of the Pacific Gas & Electric Company, gave assurance that the company's plant on Main street will be removed within the next two years. The gas company officials also stated plans are under way to lay a high pressure gas main from Sacramento to Woodland along the state highway, incidentally supplying Washington, Davis, University Farm and all residents along the line. Should the main be laid, gas will no longer be manufactured in Woodland. The gas officials stated that hereafter the company would sink wells to furnish its own water.

LOS ANGELES, CAL.—The initial payment for the Southern California Edison Company's gas properties, and the gas property of the Long Beach Consolidated Gas Company has been made by the Southern Counties Gas Company. The papers which finally closed the deal were signed by W. A. Brackenridge, vice-president and general manager of the Southern California Edison Company and F. R. Bain, president of the Southern Counties Gas Company. Officials of the companies refuse to state the exact amount paid for the properties. It is reported, however, that the consideration was between \$3,000,000 and \$4,000,000. One of the conditions of the transaction involves the approval of the State Railroad Commission, to which the proposed transfer will be submitted as soon as the detailed descriptions of the properties can be prepared. No action will be taken on the transfer of the properties to the new owner until the commission has approved of the sale, according to officials of the Edison Company.

TRANSMISSION.

CATHLAMET, WASH.—The city council has granted a franchise to James G. West to use all the streets and highways in Cathlamet to erect a line for transmitting electricity.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company has placed in service its two big submarine cables across the bay, just completed. The cables extend from the Exposition grounds to Yellow Bluff, near Fort Baker. Each cable four inches in diameter, consists of lead pipe wrapped with steel wire. Three conductors, made up of 37 small wires, carrying the current, run through each cable. Heretofore the company has relied chiefly on its steam plant for the generation of current for supplying San Francisco, and the cables are the first under the bay to be used by the corporation. They will be fed by several mountain power plants.

TRANSPORTATION.

MARTINEZ, Cal.—The Martinez & Concord Interurban Railway Company has applied to the trustees of Martinez for a franchise to construct and maintain an electric railroad over portions of certain streets. Sealed bids will be received up to March 6th for the proposed franchise.

SAN FRANCISCO, CAL.—The board of works has filed a tabulation showing that the Municipal Railways available cash in the treasury amounted on December 31 to \$437,000. This is the sum that the supervisors may use for extensions or purchasing United Railway lines. It includes \$200,000 that was set aside as an investment fund, of which \$124,500 has been invested in the city's library bonds, maturing July 1st next. The purchase by the city of the United Railroads lines west of Twin Peaks is under consideration.

LOS ANGELES, CAL.—Plans for the extension of the Pacific Electric lines will be carried out on a large scale during 1916. The first improvement to be completed will be the construction of the elevated track from the rear of the Sixth and Main Terminal over private property and across streets to San Pedro street. The second extension is on Ionia avenue, a cut off which will connect the Redondo line with El Segundo. Further plans for the proposed subway to the west coast beaches will be made. In addition to local improvements it is reported that possible extensions to San Diego and Santa Barbara will be considered.

TELEPHONE AND TELEGRAPH.

BURBANK, CAL.—The only bid submitted for a telephone franchise was that of the Pacific Telephone & Telegraph Company and the franchise was granted to them.

PULLMAN, WASH.—Improvements costing \$4600 will be made at the Pullman office of the Pacific Telephone & Telegraph Company, according to the statement of C. K. Hickman.

OTHELLO, WASH.—A meeting was held here recently for the purpose of organizing a telephone Company. J. F. Lee was chosen chairman and P. J. Vandenburg, secretary. The company will probably be incorporated and a line built from Othello to Hatton.

EL CENTRO, CAL.—The Imperial Telephone Company has announced that it will construct a new central exchange building and offices on the site on State street. The project calls for an additional investment of \$32,600. The building itself will cost \$5000, the balance will be spent for equipment. Specifications are in the hands of contractors.

SAN FRANCISCO, CAL.—The following bids were received by the chief of the bureau of yards and docks, Navy Department, Washington, D. C., for construction of five

buildings at the naval radio station, Cavite, P. I.: J. F. Tillman Co., Portland, item 1, \$141,750; 2, \$123,640; 3, \$500. Construction & Engineering Co., San Francisco, item 1, \$54,000; 2, \$42,800; 3, \$200.

WATERWORKS.

MCCAMMON, IDAHO.—The city has voted \$20,000 bonds for waterworks.

REXBURG, IDAHO.—The city is investigating the feasibility of a new waterworks system.

SEWARD, ALASKA.—Seward Water Power Company's plant is reported sold to Easterners for \$200,000.

LOVELOCK, NEV.—At the recent special election bonds in the sum of \$90,000 for a new water system carried.

SPOKANE, WASH.—Coulee City people are organizing a stock company to install waterworks and light systems.

NORTH YAKIMA, WASH.—Bids were opened January 21 for 75,000 bonds issue for water department extension.

RITZVILLE, WASH.—Proposed paving of Main street will necessitate laying cast iron water mains and surface drains.

OLYMPIA, WASH.—Bond issue of \$110,000 voted to purchase private water system; \$22,000 to be used for improvements.

DOWNEY, IDAHO.—W. D. Colton, of Idaho Falls, is named as engineer on a proposed waterworks plant at this place.

SEAL BEACH, CAL.—A bond election will probably be held soon for the purpose of acquiring water, sewer and street lighting systems.

COLVILLE, WASH.—City officials are considering three sources for better water supply. D. H. Sawyer, hydraulic engineer, has investigated the supply.

SACRAMENTO, CAL.—Sealed bids will be received for furnishing materials and constructing an addition to the city water works at Front and Ninth streets, up to February 8th.

SUNNYVALE, CAL.—The trustees have instructed the water superintendent to make necessary extensions of the water system on Mathilda, Washington and McKinley avenues.

ABERDEEN, WASH.—Plans will probably be prepared soon for \$350,000 waterworks system. L. D. Kelsey, city engineer, and R. H. Thompson, of Seattle, is consulting engineer on the project.

VENTURA, CAL.—Notice of intention of the Palo Verde Water Company to create a bonded indebtedness of \$500,000 has been filed in the superior court. The chief place of business of the company is Oxnard.

BOISE, IDAHO.—The Idaho Improvement Company, a private concern, will probably spend \$10,000 in enlarging its waterworks system, and the Coeur d'Alene people are talking of water system improvements.

ALBION, WASH.—Mayor Crawford and council plan to install a system of waterworks. The committee to secure a site includes Councilmen C. E. Wright and C. E. Calvert. The question of bond issue to be submitted to voters.

BOWIE, ARIZ.—The Southern Pacific Company is serving a six months' notice to Bowie that after June they will cut off the water supply to the public. It is probable that the town will issue bonds and put in a water system.

LOS ANGELES, CAL.—The public service commission has instructed Chief Engineer Mulholland to appraise the water plant in the Rose Hill District and report what would be necessary to give the district an adequate system.

LOS ANGELES, CAL.—The board of supervisors has adopted resolutions awarding contracts for furnishing water pipes for the Los Angeles County Water Works District No. 3, to the Llewellyn Iron Works, and to the Lacey Manufacturing Company.

POCATELLO, IDAHO.—The city may soon start work on the proposed \$400,000 waterworks system. The city is now supplied by a private firm, the Pocatello Water Company. The city's bonds were sold in December to the Lumbermen's Trust Company of Portland.

RICHMOND, CAL.—Consulting Engineer J. D. Dockweller has completed his report. In the report is included the Sacramento water project, the Contra Costa well plan, that of purchasing the People's water pumping plant, reservoir and wells and the Marin county project.

COLVILLE, WASH.—The city authorities have become alarmed about the diminution of the water supply from the springs in Munson Canyon and a campaign for a new system is being waged for a better head, where a supply can be secured with sufficient volume to meet all emergencies.

MILWAUKEE, ORE.—Consolidation of the Milwaukee water works, the Minthorn Springs Water Company, and the Bellwood Water Works into one company for the purpose of furnishing Minthorn Springs water to the people of Milwaukee is a new plan taking form here. It is planned to organize an entirely new company, take over the three plants, establish a pumping plant at Minthorn Springs and operate all three plants as one.

SACRAMENTO, CAL.—The water report for Sacramento by Experts Wilhelm and Hyde is practically completed and will soon be submitted to Commissioner of Public Works Thomas Coulter. It is understood that the document will review the three sources of water supply investigated—mountain, river and wells—very fully and that it will recommend that the city continue to use the water from the river, but that a filtration plant, at a cost estimated at about \$1,000,000, be installed. One of the experts, Professor Charles Gilman Hyde, formerly prepared plans and specifications for the city several years ago. The cost of the plant at that time was estimated at \$660,000.

SALEM, ORE.—Until the question of whether the state public service commission has jurisdiction in Carey act projects or private corporations is decided, hearing before the commission of the complaint of the Central Oregon Irrigation Company Water Users' Association against the Central Oregon Irrigation Company will be postponed. This was ordered Saturday when the Supreme Court issued a writ of prohibition, delaying the hearing set for next Monday at Bend. The court set February 3 as the time for hearing arguments on the question of the commission's jurisdiction. The water users' association alleges that unless the company makes repairs the system will be of little value when the settlers take it over two years from now. In its reply the company alleges that the settlers are behind in their payments.

SALEM ORE.—Permits for irrigating 87,329 acres of land, developing 30,766 horsepower and storing 285,669 acre-feet of water were issued last year by State Engineer Lewis. The permits number 581 and the total estimated cost of all the projects under them is \$5,349,152. Under the rights issued provision is made for municipal water supplies for Portland, Tillamook, Oregon City, Gaston, Amity, Falls City, Milton Cove, Halfway, Eastside, Marshfield, Lakeside, Newport and Reedsport. Besides permits for irrigation, power and municipal supply, a large number have been issued for individual domestic supply, manufacturing and other uses to which water is applied. Malheur county led last year in number of permits with 109. Josephine follows with 47, Harney 42, Baker 41, Grant 40, Crook 34, Jackson 34, Wallowa 30, Hood River 28, Coos 23, Umatilla 17, Tillamook 12, Wasco 14, Lake 13, Wheeler 11, Klamath 11, Douglas 10, Union 9, Curry 8, Jefferson 7, Lane 7, Morrow 3, Clatsop 2, Lincoln, Sherman and Gilliam 1 each. In the Willamette Valley 23 permits were issued.

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SAN FRANCISCO, FEBRUARY 12, 1916

PER COPY, 25 CENTS

MOUNTAIN KING MINING COMPANY'S POWER PLANT.

BY RUDOLPH W. VAN NORDEN.

THE ELECTRIC POLE NUISANCE.

BY J. E. MacDONALD.

PROBLEM OF COLUMBIA RIVER FLOOD CONTROL.

BY L. F. HARZA.

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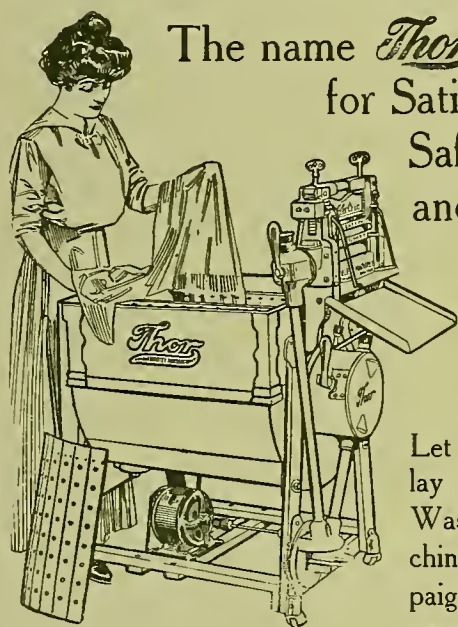
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MOUNTAIN KING MINING COMPANY POWER PLANT

BY RUDOLPH W. VAN NORDEN.
Mem. A. S. C. E.; Fel. A. I. E. E.

There are probably many mining prospects in California which give evidence of extensive values and which could be developed into gold producers of importance, if it were possible to obtain cheap power in sufficient quantity. These are the low-grade ore bodies which must be developed and operated at low cost per ton of ore. Such properties may be found in

and more so as the power companies grow and expand, but there are hundreds of such properties to which the power lines of the transmission companies may not reach, and to these the solution of the power problem presents itself as the principal means of existence.

About a decade ago a company was formed to develop a mine in a mountain which rises out of the can-



Mountain King Power Plant and Suspension Bridge.

all stages of development, from a mere hole in the ground, to old properties containing miles of workings with costly plants, long records of money poured in, but with little to show on the right side of the balance sheet, where profits and dividends should be. The possibility of power application through electric motors, wherever it may be desired, after the plant has been designed for high efficiency, a minimum of lost or needless motion, and a centralization of operations, can make possible the commercial development of the prospect, or turn the producing failure into a bonanza.

It is possible now to transmit electric power into many of the mining districts, and will become more

yon of the Merced River, not a great distance below the gateway of the Yosemite Valley, in Mariposa county. This canyon was uninhabited and almost inaccessible. There were no roads within a dozen miles of the locality and the occasional miners' trail was almost a figment of the imagination. Here, aside from promising outcrops and good prospects, was the possibility of water power from the Merced River, for the river, at this point has considerable grade.

A tunnel was started into the mountain side, 800 ft. from the river, its portal being at the bed of a ravine about 2000 ft. above the river. To obtain the water power at the mill and at the same time, to place the mill as near as possible to the mine, it was neces-

sary to locate the mill on the river bank and at the mouth of the ravine. Below the site of this mill the river bed falls 100 ft. to the mile where it passes through a gorge, but above the millsite, the fall is much less, being but 40 ft. in two miles. As it was necessary to deliver the power from a water wheel directly to the shafting in the mill, it was necessary to utilize the fall in the river above the mill. With this plan in view a wide and low, log and gravel dam was built, together with a wooden flume about two miles long. By the time this flume had reached the mill, the available head in the penstock was but 24 ft. About 75 h.p. was obtained by this means, enough to drive a ten-stamp mill and small air compressor. So far this was good, but the mill was of necessity at the river's edge almost a half mile from the mine entrance. This required transporting the ore, first in cars out of the mine, then a transfer to a second car system operating on an inclined tram to the mill. This tram was of the balanced car type. As an ore transporting system of small capacity it was the best arrangement possible, but of little value for carrying lumber and supplies from the mill to the mine.

Soon after the mill was placed in operation, the Yosemite Valley Railroad was built up the Merced River. This line passed close to the mill and a station was established there. Development within the mine gave a new portal at a lower level than the earlier workings, and, while this entrance was in the bottom of the canyon 1000 ft. from the mill, it was in altitude but 300 ft. above it. A new inclined tram was built, but aside from a smaller drop and a shorter line, it possessed all of the disadvantages of the first one. The development had been, so far, sufficient to keep the ten stamps going, but to keep ahead of expenses it was necessary to add more stamps and more power.

In 1910, a battery of 20 stamps was accordingly added and a 50 h.p. distillate engine installed.

Between the high cost of power and the inefficiency of the transportation system between the mine and mill, the property was closed down in 1912. Late in 1913 the company was reorganized, new money introduced and the mill again started. While the ore values were present the power problem had not improved; the old timber flume was almost at the end of its usefulness and the entire property was rapidly disinte-

grating. By frugal operating, it was possible to pay expenses and the mill was run in a small way. It was readily seen that a successful future was possible only by installing a modern plant, making every possible economy and above all after such a plant had been designed and constructed, to have ample power available. These needed improvements were all impossible with the old plant and waterpower.

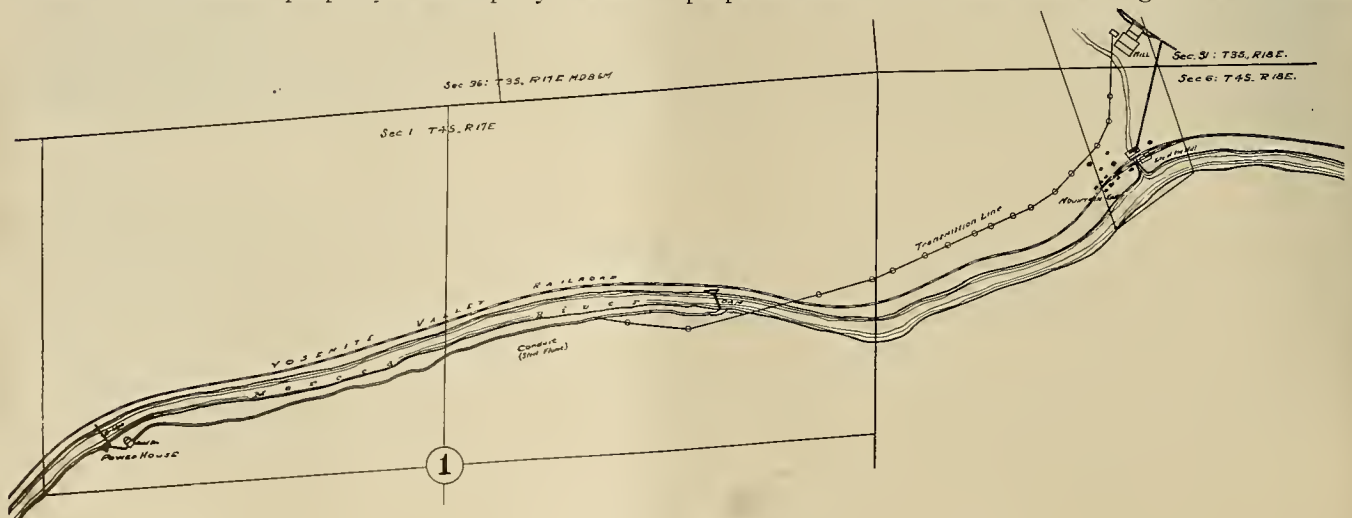
To install a new plant meant a large expenditure of money, which must be raised, either by making the old mill produce it, or by assessing the stockholders. The first method except in a small way was out of the question, the latter a tedious and difficult undertaking and impossible except within comparatively narrow limits. To obtain power from the nearest existing line required the construction of a transmission line over rugged mountains a distance of about 15 miles. But the possibility of developing sufficient power in the rugged canyon below the old mill was attractive.

At this point, in August, 1914, the writer took up the study of the problem of power development and a new plant which would be capable of treating all of the ore that the mine could produce and embrace every possible economy. Low first cost was an absolute essential and low operating cost a necessity, otherwise the property would have little commercial value. The result of this study was the designs for a power plant, milling plant, mine railway, etc., by the writer, and construction of the work by contract under the personal supervision of the writer. The power plant is described in the following pages:

Dam.

A reconnaissance survey was made in that part of the canyon below the old mill where it appeared that the most economical and efficient plant could be located, where sufficient power might be obtained to operate the mining plant both for present needs or for any future requirement and where designs of the various parts might be employed in the construction in which the cost would not be outside of the financial resource of the company.

The survey, which was entirely on Government land outside of the Forest Reserve, disclosed a number of relatively difficult problems, due to the heavy angle of slope of the canyon side, this varying from perpendicular cliffs at the river's edge to a minimum



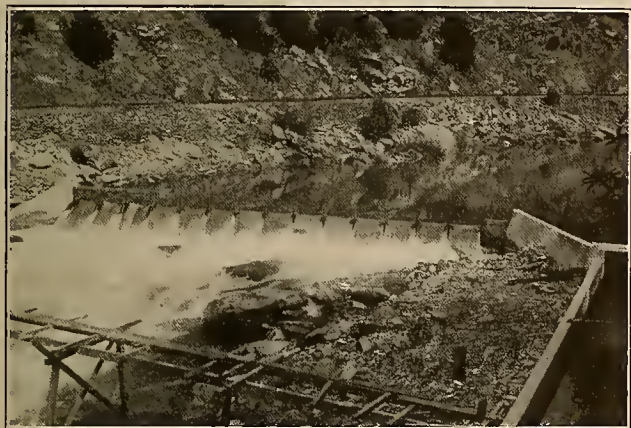
Outline Map of Installation.

slope of 40 degrees with the horizontal somewhat above the high water line. This condition was accentuated by the extreme hardness of the bedrock. Other conditions to be met were the great difference in elevation of the river's surface between low water and high water, under the latter condition the river becoming a raging torrent. The further fact that the location of the Yosemite Valley Railroad on the north bank of the river, which at some points is scarcely above the high water level, precluded the possibility of locating a diverting dam which would, under high water conditions, raise the river above the natural level and thus menace the railroad. To construct a low diversion, operative during low water by an adjustable crest, meant a low elevation for the conduit, which if so placed would be actually submerged during the high water period for a considerable part of its length. A good location for a dam was found about three-quarters of a mile below the mill, where the bottom consisted partly of bedrock and partly of large boulders firmly imbedded; in fact, these rocks formed a sort of natural dam which made a fall in the river of about 4 ft. The writer determined to build here a reinforced

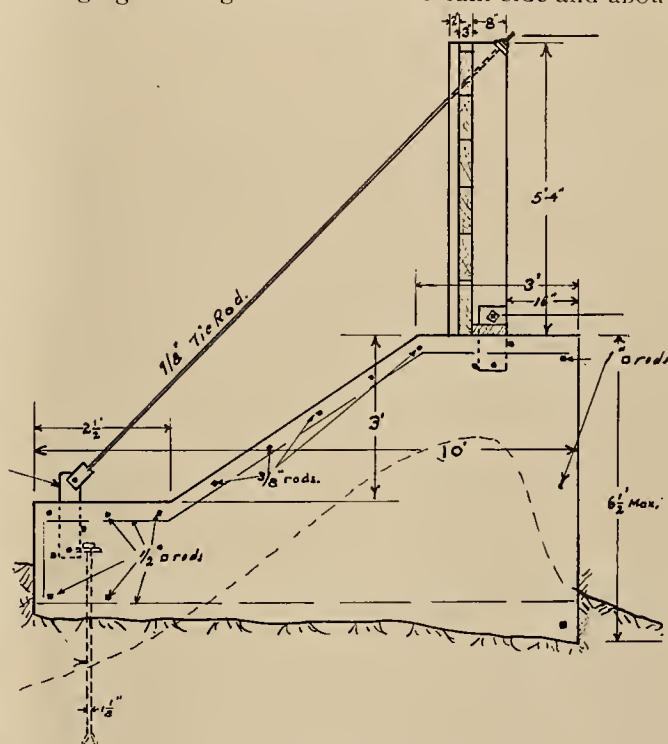
filled with rock and decked over so that high water will pass over without causing damage.

Work on the dam was commenced October 10, 1914, on the south half of the dam proper, allowing the river flow, which varied from day to day, from 150 to 300 second feet, to occupy the north half. Sand-bag cofferdams were built to keep out the water where the work was proceeding. In placing the concrete in the south half, a notch 12 ft. long and 3 ft. deep was left open to allow the flow to pass while working on the north half.

The dam was designed as a solid beam, 88 ft. long, averaging 6 ft. high on the downstream side and about



The Dam, showing Part of Flashboards in Place.



Typical Cross Section of Dam.

concrete gravity dam incorporating therein a part of the rocks of the natural dam and anchoring as much of it as was possible to bedrock. The crest to be only slightly higher than the original rocks. By this means an easement was provided which would offer actually less obstruction to flood flow than did the original rocks, and hence, would not raise the water level to menace the railroad.

For low water flow conditions a system of flashboards was adopted which could raise the pond formed by their use to a sufficient height for entrance of the flow into the canal. A wing wall at the south end of the dam was built for diverting the flow and this wall was carried for a distance of 200 ft. to form a canal which was otherwise excavated out of the sidehill. Near the end of this canal the excavation was carried through a projecting point of bedrock and here a natural deflector was formed to turn away the force of the river when it is high enough to submerge the canal, and in this cut is a pair of diagonally placed head gates. The canal wall acts also as a wasteway. The north end of the dam terminates in an end wall which continues upstream and into the bank as a diagonal deflecting wall. The downstream end of the endwall terminates in a heavy buttress to carry all downstream and end strains. The space behind the endwalls is

3 ft. high on the upstream side. The lower face is vertical and the upper face has a gentle slope from the average bed of the river above the dam. The dam was reinforced longitudinally and transversely in both faces and on top so that, in case there should be any possibility of a washout under any of the part not on bedrock, there would be no danger of rupture or deformation in the dam. This precaution was taken notwithstanding that the dam is at all points below the natural bed of the river. Reinforcement was also calculated to withstand any twisting strains which might be set up in the event that a flood should overtake the dam when the flashboards were in place.

In designing for stability, the possibility of full uplift pressure was considered when the head of water was three feet over the top of the flashboards which is the point at which they are designed to fall and wash out. Aside from its natural stability, about one-half of the entire length of the dam is anchored to bedrock by heavy steel wedge anchors placed near the upper toe.

In building, a 1:2:4 cement, coarse sand and crushed rock concrete was used to a thickness of two feet in the upper and lower faces and the deck, making a sort of box section, while the filling consisted of the same grade of concrete, but freely filled with plums as

large as two men could carry. The end walls are reinforced for flood strains and are thoroughly tied in with the main crest.

The flashboards are made of 3 by 10 in. Oregon pine lumber, surfaced on one side and two edges. They are 5 ft. long and when all are in, raise the water above the crest 5 ft. 2 in. The flashboards are supported between 6 in. by 13 in. posts, grooved to receive the boards. These posts are hinged at the bottom by a bolt which passes through the post and is held by a chair of two $\frac{1}{2}$ in. by 6 in. plates which extend into the concrete and are tied into the reinforcement. This arrangement is made so that the post may swing forward when the flashboards are out and thus lie down, or, in case high water should carry away the flashboards, the posts would not be lost. The upper end of the posts are held by $\frac{3}{4}$ in. rods which tie into heavy steel anchors imbedded in the concrete and tied into the reinforcement in the upper face of the dam. The ends of these rods were turned down to a $\frac{5}{8}$ in. diameter from the holding nut and washers. The diameter at the bottom of the thread is $\frac{1}{2}$ in. With water at the top of the flashboards, the factor of safety is 4, but should the river rise 3 ft. above the top of the flashboards, the rod will break at the nut, allowing the post to swing forward and the flashboards to wash out. The three end panels at the north end of the dam have double posts and the boards are spiked on. These are intended as emergency flood gates. They are held in place by heavy yokes which in turn are held by a clevis and coupling pin to the strain rods. In the event of a sudden rise in the river these pins may be pulled out and the gates can then lie down and relieve the water sufficiently to allow the removal of flashboards.

To facilitate the removal of flashboards, or to clear the dam of trash during high water periods, a $\frac{3}{4}$ in. plow-steel cable has been suspended across the river directly over the line of flashboards. A small, "flying Dutchman," or car hung from two trolley wheels traverses this cable.

Flume.

At the end of the entrance canal and 200 ft. below the intake the flume commences. This flume is interesting from the fact that every post is solidly anchored to bedrock and the flume may be submerged without danger of losing its alignment; also, that any section may be taken down and replaced in a few hours in the case of rock slides which might menace the structure; also, that it is very crooked, notwithstanding the fact that it appears to be quite straight to one observing from the railroad across the river.

The flume has a total length of 3737 ft. A more difficult location for a water conduit would be hard to find, as, with the exception of the last 600 ft., the supporting ground consists of water worn cliffs and jagged promontories of hard rock. To have followed the contour of the ground would have been impossible and the final location and attendant height was a compromise between the cost of lumber and the cost of benching out the rock promontories. Much blasting was, of course, necessary and this required hand drilling, which in itself was expensive, due partly to the extreme hardness of the rock and partly because of inaccessibility, for, in many places it was necessary

for the driller to be suspended from a rope fastened above the cliff.

The unit costs in the construction of the flume, compared with similar flumes in a less difficult location, were high, notwithstanding that the utmost economy was exercised and the closest supervision given to all features of the work. These costs can probably be taken as a maximum for flume of this character in most difficult locations and, at that, are considerably less than an all wood flume of good construction and equal carrying capacity would have been.

The following is a brief segregation of costs per lineal foot of flume in place.

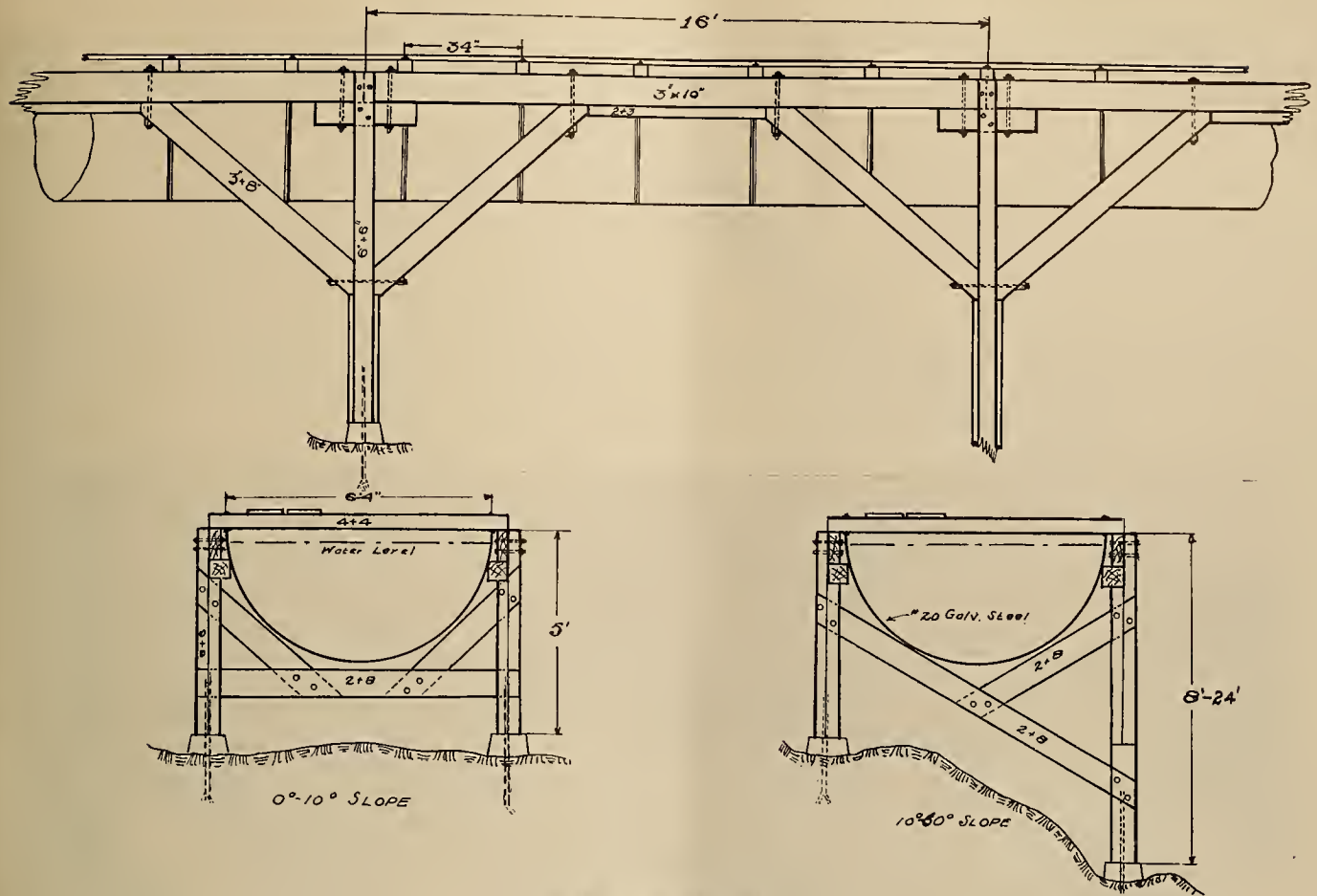
Rock excavation	\$.45
Post hitches and holes, and placing pins.....	.157
Lumber: Total amount, 96,480 ft. B. M. Per lin. ft. 25.75	
" Cost on cars delivered, at \$22 M. B.M.....	.568
" Cost transporting to place of use.....	.145
" Framing, at \$29 per M. B.M.....	.747
Bolts, washers and lag screws.....	.182
Flume steel, delivered.....	1.60
Flume steel, transporting and setting up.....	.185
Surveying and overhead.....	.094
Total cost of flume per linear foot.....	\$4.128

A crew of four men and a straw-boss was found to be most efficient in placing the steel sheets and, due to the height of structure, falsework was required throughout the length of the flume. This was constructed by the steel crew as they progressed. The average daily progress was 98 lin. ft. of flume.

Cost of carpenter work varied between \$15 per M. ft. B.M. for setting up posts, to \$46 per M. ft. B.M. for cutting and fitting stringer braces. The overall cost was \$29 per M. ft.

The flume is made of No. 20 gauge galvanized steel sheets, 36 in. wide and $12\frac{1}{2}$ ft. long. It was furnished by the Hess Flume Co. of Denver, Colo. The form is semi-circular and the diameter 6 ft. 4 in. The gradient of the flume is 0.1 per cent, or 5.28 ft. per mile; the nominal carrying capacity is 82 cu. ft. per second, equal to 3280 miners' inches.

The steel sheets have depressed "S" grooves rolled into both longitudinal edges, the grooves on one side being slightly deeper than on the other so that adjoining sheets fit snugly without a projection on the inside edge of the flume. After being fitted together a flat steel bar with beveled edges, rolled to the same curve as the sheets is laid in the grooved joint. This bar is $\frac{3}{16}$ in. thick and its upper side is flush with the inside surface of the sheets. The bar has a two-fold purpose; it forms a smooth surface at the joint for an even water flow; it also acts as a backing against which the joint may be drawn thus making a watertight joint. The ends of the bar rest against a wedge shaped malleable iron chair, or stop, placed on the under side of the cross timbers which carry the flume. Around the outside of the joint is a $\frac{1}{2}$ in. round steel carrier rod which passes through the chair and also the cross timber and terminates in a washer and nut on the upper side of the timber. The carrier rods carry the weight of the flume and its load and by means of the nuts is tightened, thus drawing up the joint against the inside bevel bar. In the construction and setting up of the flume, the sheets were shipped from the steel mill flat with the grooves already in. Both the sheets and bevel bars were rolled at the point of unloading. It is impossible to make the slightest



Steel Flume Sections.

curve or change in direction by bending or straining the joints in this flume and as there were many curves to be installed a simple plan of procedure was followed: In making the final location of the flume all curves were made at support points which were nominally 16 ft. apart. These curves were laid out to have angles of departure of $2\frac{1}{2}$ degrees or multiples thereof. The total curvature was found and a proper number of sheets were tapered on one side so that when rolled the tapered side would bear the desired angle. These tapered sheets were made partly with a $2\frac{1}{2}$ degree taper and partly with 5 degrees taper. This arrangement for making curves was found to be satisfactory and, aside from taking slightly more time in setting up the sheets was handled in the same manner as was the straight sections. As each sheet was about to be placed into position, the joint was well swabbed with asphalt paint. This served to insure a water-tight joint and also to prevent rust in either the joint or the bevel bar.

The flume superstructure is supported by posts, nominally 16 ft. centers. These posts are 6 by 6 in. Oregon pine lumber, the outer posts averaging 16 ft. length and the inner posts about one-half that length. In placing the post, its location was carefully determined by the surveyor with the idea of preserving strict alignment of the flume. Posts in all cases were placed on bedrock after the latter had been moiled to a level hitch. A 1 in. diameter vertical hole was first drilled into the bedrock 10 in. deep and a $\frac{7}{8}$ in. iron rod, 2 ft. long was driven into the hole and wedged tightly. A similar hole was bored with the grain, into the bottom of the post, and the post was then straightened up and

driven home over the standing iron dowel. The bottom of the posts were treated with carbolineum and then a cement grout was run under the post to give a true setting. This method of anchorage was found to be sufficiently secure to withstand any upward strain which might be brought tending to dislodge the flume or posts. Every post throughout the length of the flume was anchored in this manner. The tops of the posts were framed into a carrier timber, 4 in. by 6 in. by 3 ft. long, except at angles when this carrier was cut from 6 by 6 in. material. These carried the stringers which are 3 in. by 10 in. by 16 ft. long. The carrier is bolted to the post as are also the ends of the stringers, while the latter are bolted downward through the carriers. The knee braces cut from 3 in. by 8 in. timber, were carefully framed to the posts and bolted through the ends of the stringers and posts respectively. A 2 in. by 3 in. batten spiked to the under side of the stringers served as a butt piece between the adjacent ends of the knee braces, while 2 in. by 6 in. butt pieces were spiked to both sides of the posts and extend from the bottom of the kneebraces to the base of the post. Outside of the butt pieces all joints in the substructure are bolted together. On one occasion, when a large rock slide threatened to carry away the flume, the structure was unbolted, the sheets removed, the loose rocks started downward to the river through the gap so formed, and the flume section was replaced all in the period of a few hours by a couple of men.

During the period of high water, the first 1000 ft. of this flume might be submerged, partially or wholly. At exposed points where heavy floating debris might strike a post and break it, double posts have been in-

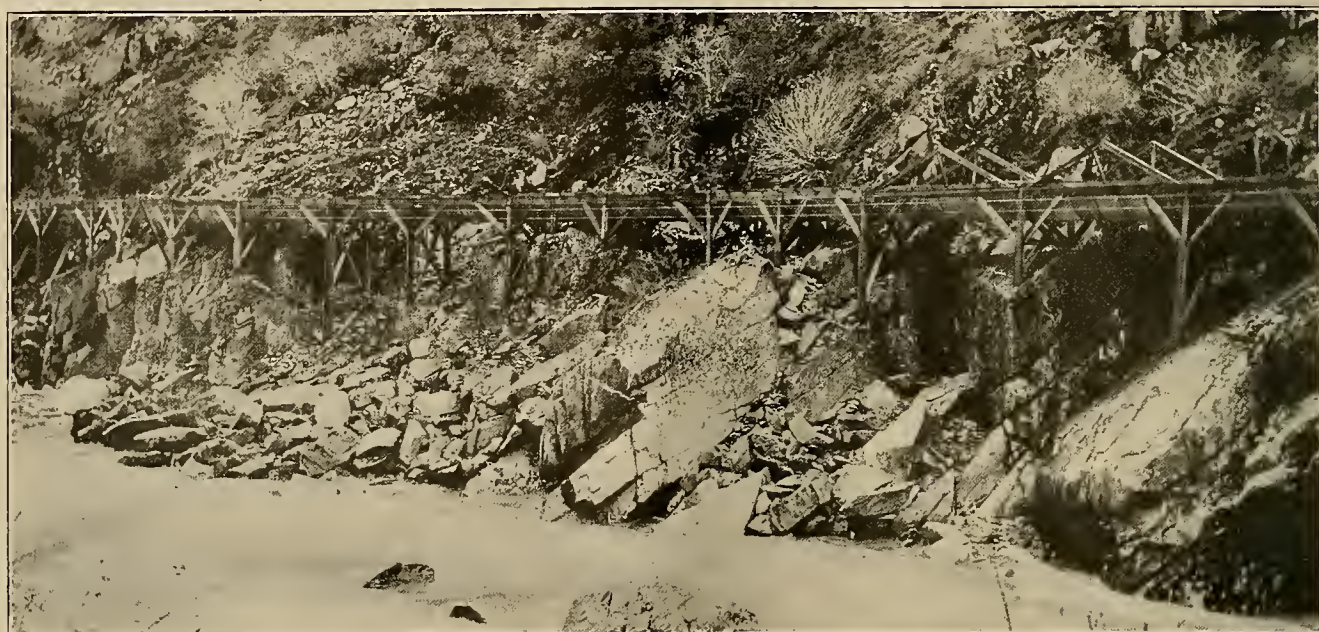
stalled and these are battened together to further resist a blow. Where the span between posts was greater than 16 ft., and not over 20 ft., 4 in. by 10 in. stringers were used and a simple truss, 3 ft. deep was constructed to further strengthen the span. Where the span is over 20 ft. the stringers are made of three pieces of 3 in. by 12 in. lumber spiked together and a two panel truss added on each stringer. At a point about 1000 ft. below the intake is placed a steel wastegate.

The flume terminates in a timber headbox. This is 24 ft. by 8 ft. by 8 ft. inside. In this are placed three galvanized steel waste gates 30 in. square. Beyond the wastegate is a sand barrier extending 2 ft. above the floor of the box and from the top of this

stock continuing to the power house is perfectly straight. It is supported on reinforced concrete chairs every 12 ft. with more or less backfill between the points of anchorage. The lower end of the pipe terminates in a steel taper 6 ft. long. This taper piece is anchored in concrete and at its lower end, after passing through the rear wall of the power house building bolts directly to the scroll casing of the turbine.

Power House.

The power house is placed on a sheer porphyry wall at the entrance of a box canyon. The river at this point is narrow and the flood water line as high as twenty feet above the low water flow. The problem presented here was to place the machinery and the floor level of the building above the point of highest



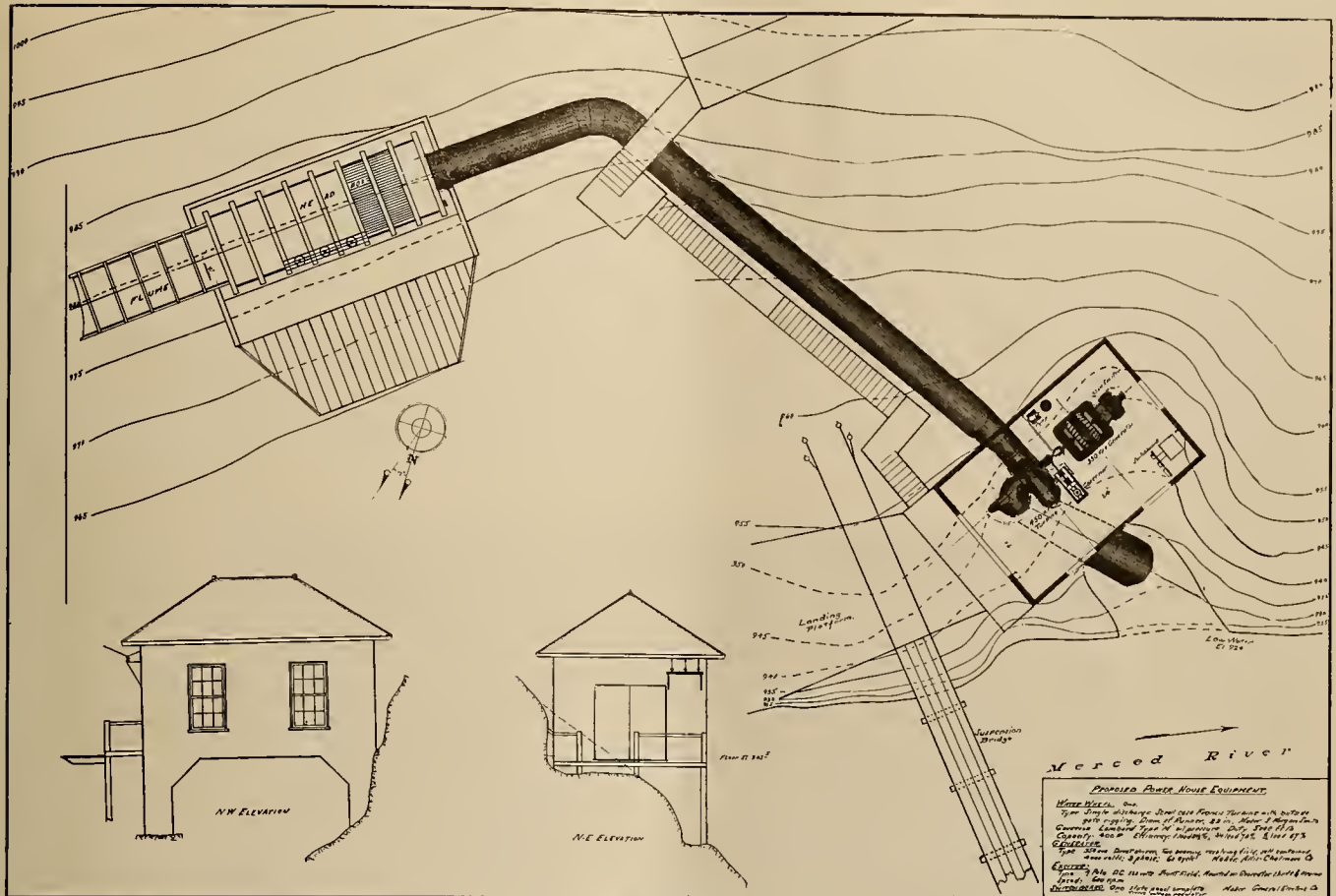
Difficult Flume Construction.

barrier and sloping backward at a 1:1 slope is a wooden bar grizzly covered with a $\frac{1}{2}$ in. mesh galvanized wire screen. The front side of the headbox is cut below the level of the top of the flume and acts as a waste wier. With no water passing to the power house and a full head entering from the flume, this waste wier will discharge the entire flow. With the power house using all of the water, the water level stands at the crest of the wier, hence giving automatic regulation.

The headbox was, of necessity, built at a point where the entire mountain side is an ancient slide, and while of very compact boulders and earth, there is probably no bedrock close to the surface. To prevent the danger of dislodging the headbox, caused by leakage or overflow, a reinforced concrete apron with low walls on three sides was laid in the bench excavation. This apron was carried down the natural slope for 6 ft. and terminates in a long wooden apron which carries the overflow away from the hillside. The headbox is mounted on posts which in turn are placed on sills on the concrete apron, the whole structure being thoroughly braced. The penstock, which is a redwood stave pipe, 4 ft. inside diameter, enters the end of the headbox opposite to the flume inflow. There is a short horizontal section terminating in a riveted steel elbow in which the composite horizontal and vertical angle is 67 degrees, from this elbow, the stave pen-

water, and, at the same time with a workable draft head to low water, so that the full fall could be utilized at all times. It was also necessary to have a solid foundation for the machinery, and yet, not desirable to carry the building foundations into the river to obstruct the flood water flow. This condition was aggravated from the fact of the extreme hardness of the bedrock, making bench excavation difficult and costly.

The power house, while ample in size, and arranged for utmost convenience of operation is 24.5 ft. long and 16 ft. wide, inside measurement. The bedrock was benched for the length of the building to a width of about 9.0 ft. On this bench, with its axis parallel to the length of the building, was placed the single generating unit. At the two forward corners of the building are two heavy reinforced concrete columns whose reinforcement is carried into bedrock, and which are tied by heavily reinforced walls back to the bedrock at the floor level. Across the front of the building and supported on the two columns is a reinforced concrete beam which carries one side of the suspended floor and the front wall of the building. The power house floor is a single reinforced concrete slab, 6 in. thick. The walls of the building are 2 in. by 6 in. timber studs spaced 12 in. centers and these are covered outside and in with herringbone metal lath, which, in turn is plastered with a 3:1 cement plaster,



Plan of Power House Layout.

there being three coats and pebbledash finish on the outside and two coats with float finish on the inside. The roof trusses are of timber and are covered with No. 24 gauge galvanized corrugated iron. A stamped sheet steel ceiling is suspended on the lower chords of the roof trusses. With this construction the building is practically fire proof inside and out. A simple I-beam travelling crane of 4 tons capacity was provided.

The generating unit consists of a Francis scroll-case turbine, direct connected through a bolted flange coupling to a 350 k.v.a., 3-phase generator. The generator shaft is extended at the further end to carry the armature of the exciter which is mounted on a castiron shelf bolted to the base of the generator.

The turbine has a capacity under maximum head of 450 h.p. The entrance of the scroll case where the taper from the penstock bolts on, is 36 in. diameter. The scroll is built up of $\frac{1}{4}$ in. steel plates carefully shaped to preserve the hydraulic curves. The upper and lower speed rings are thoroughly bolted to the inner rims of the casing and are bronze lined and bushed to carry the gates. The gates are cast steel, carefully finished and are carried on steel pins which extend through the upper speed ring and to the ends of which are keyed the bellcranks which in turn are connected through breaking links with the shifting ring. The gates are balanced to have a closing tendency above quarter load. The runner has a nominal diameter of 21 in. and is made of curved steel plates about the ends of which are cast the hub and rim. This runner is of a high specific speed type, the specific speed being 80 and the speed factor 87. Water after leaving

the runner enters a quarter-turn which discharges into a conical draft tube 24 ft. long having an outlet 5 ft. in diameter, and which is made of sheet steel plates $\frac{1}{4}$ in. thick. To overcome the hydraulic thrust of the runner, the shaft is carried through the quarter-turn into a "Gibbs," thrust bearing. This consists of a flat disc at the end of the shaft having a babbitted face which bears against a similar castiron plate in which are cut four radial grooves. The stationary plate has a spherical bearing on its back and is carried by the castiron cap and enclosing structure which bolts to the quarter turn. The weight of the thrust-bearing is carried by a hollow pedestal which acts as an oil reservoir. The oil contained therein is constantly pumped by the motion of the disc and the aid of the four radial grooves between the faces of the discs. A cooling coil through which water from the penstock circulates is placed in the pedestal to keep the oil cool. Placed between the turbine and generator and extending forward into the operating space is a type M, 5000 ft. lb. Lombard governor. The connection between the governor piston and cross-head is direct through a link to a lever on a rocking shaft and from which the push and pull rods move the gate shifting ring. Placed in the rear of the machines is an oil pump and reservoir, the former being driven by belt from the hub of the coupling between the turbine and generator. The entire operating mechanism is well balanced and moves with great ease and the automatic governing is remarkably satisfactory. The turbine and governor connections were built by the S. Morgan Smith Co.

The operating head varies from 63 ft. at low water to about 50 ft. in flood periods.

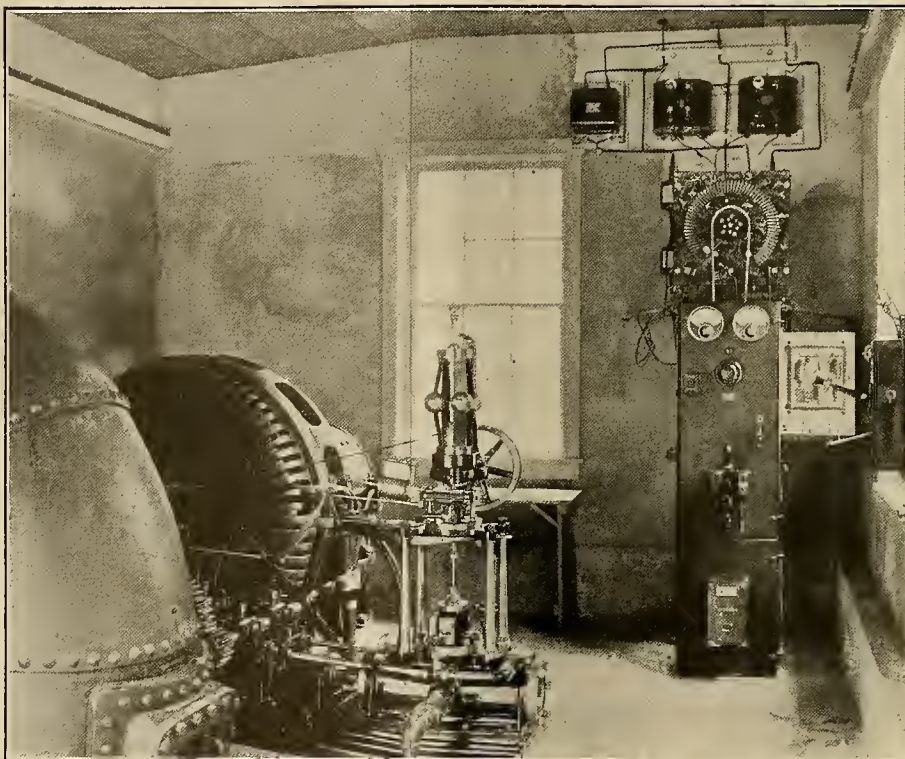
The generator is of a standard type with two pedestal bearings. It delivers 3-phase current at 4000 volts and is rated at 350 k.v.a., with 40 degrees temperature rise in the armature at rated load.

The exciter is rated at 7.5 kw., and has four poles which are shunt wound. An outboard bearing carries the end of the exciter shaft. The unit is driven at 600 r.p.m. The generators and also motor equipment at the mill and the transformers were furnished by the Allis-Chalmers Manufacturing Company.

A single black slate panel switchboard is equipped with ammeter, voltmeter, integrating poly-phase wattmeter, Tirrill regulator and outgoing automatic overload oil circuit-breaker. This is ample apparatus for complete control as there is but the one outgoing circuit leading to the mine.

danger of high water in the river getting close to the wire, the line leaves the flume and is carried on structures on the hillside to a point where a span 900 ft. long is made across the river. On this span the wires have a spacing of 6 ft., and to prevent the possibility of swinging together, as the result of winter winds which sweep down this canyon, the span is given a one-quarter turn so that the wires can never touch each other. From the north side of the river the line is carried on poles to the transformer station at the mine.

There are three 100 k.v.a., 4000 to 440-220 volt oil immersed and water cooled transformers. These are mounted in a small corrugated iron ventilated structure. Both primary and secondary are delta connected. All motors are 440 volts while the camp light-



Interior of Power House.

The power plant is self regulating and requires but occasional attendance, the only difficulties in continuous operation being the filling of the screen in the head-box with trash, which requires more or less attention.

Notwithstanding that the load consists almost entirely of induction motors from 3 h.p. to 100 h.p., there being at present eleven in use, aside from a locomotive for hauling within the mine, both the speed and voltage regulation are practically perfect and light service could scarcely be improved.

Transmission.

The transmission line has a length of 8700 ft. It consists of three No. 4 medium hard-drawn copper wires carried on 3 petticoat porcelain insulators and wooden pins. For a distance of about 3000 ft. the transmission is supported on long arms mounted on the flume structure so that the wire is in the clear over the river. At the point where there would be

ing circuit is 220 volt, 3-wire, 3-phase. This is obtained by taking one leg from a delta lead and the other two from the middle points in the winding of the two adjacent transformers.

The locomotive, is driven by two 5 h.p., 220 volt a.c. repulsion type motors. In order to obtain the current for the trolley, the middle point of one of the transformers from which is also taken one of the lighting leads, is grounded and this connection is also connected with the rails which are bonded. The other terminal of the 220 volt railway circuit is taken from the outside of the same transformer winding, but opposite to the end supplying one of the lighting legs.

The cost of this power installation including preliminary surveying, dam, canal, power plant, transmission and transformers, and overhead expense and engineering was \$35,169. The plant will deliver 400 h.p. to the mill at all times, which makes the installed cost per horsepower delivered, \$88.

THE ELECTRIC POLE NUISANCE.

BY J. E. MacDONALD.

(After showing how the pole nuisance had been minimized in Los Angeles this paper brings out the fact that a competing municipal system, with its duplicating equipment, brings back the trouble. The paper was recently read before the Los Angeles Jovian League. The author is secretary of the Joint Pole Committee at Los Angeles.—The Editor.)

The greatest evil in the electrical industry today is the pole nuisance. It is a necessary evil, but none the easier to tolerate on that account. There are almost 100,000 poles in Los Angeles and the only hope that we may ever be relieved of this nuisance is that the requirements of every household will increase and so intensify the demand that funds may be provided for placing all wires underground in the urban districts. This possibility is so remote, however, as not to be pertinent at this time. Indeed, we shall do very well in this city if we can find some way to maintain the distributing systems as at present without the duplication of poles which is contemplated by the municipality, and which promises to increase the number almost fifty per cent.

The enunciated principles of all public service regulating commissions include the unwritten law that prohibits plant duplications where adequate service is being given at reasonable rates. In Los Angeles there is a perfectly adequate system for the distribution of electricity for light, heat and power. Rates and service are regulated by a state commission of competent authority, which ensures the lowest possible rates with perfect service. In addition to this, overhead lines have been erected on joint poles so as to reduce the pole nuisance to a minimum. In this respect, it would seem that conditions are as near ideal as possible from the consumer's standpoint. Duplication of facilities does not exceed five per cent, and this largely represents main feeder lines or construction erected many years ago, before the futility of useless duplication was recognized. The practice now is for each company to develop certain territory fully and not to construct lines in localities already adequately served by another company.

It has not been considered expedient in California to empower the railroad commission with authority to fully protect the corporation as well as the consumer. It may prohibit one corporation from paralleling another in any given territory, but it may not interfere with the municipality, which may adopt the "rule or ruin policy" with apparent impunity, thus inducing greater evils than private ownership of public utilities without any control or regulation whatever. This policy offers a menace, temporarily at least, to the existing companies.

The inability of the city, however, to recognize rights granted temporarily to private enterprise, and failure to safeguard the investments which have been made in good faith, places the interests of every citizen in jeopardy and tends to make the community a place to be shunned by the prospective investor.

The law of compensation knows no individual, corporation or municipality. It is always positive in its action, as some of you have no doubt experienced. An attempt to get something for nothing carries with it at all times the assurance that you are about to get nothing for something, and that is the exact situation in Los Angeles today. The municipality is on record

as seeking to condemn, without proper compensation, a portion of the system of the Southern California Edison Company.

For eight years municipal light and power has been known to be a prospective commercial commodity, which must be disposed of at a profit. Had there been any well defined policy or plan of action, such as governs the privately-owned utility, contracts would have been executed long ago for the entire output. Had there been any real desire to purchase a portion of the systems of the Southern California Edison Company, the Pacific Light & Power Corporation, or the Los Angeles Gas & Electric Corporation, the negotiations to effect such result need not have required eight years of delay or any useless litigation.

Some of you no doubt recollect the several propositions submitted to the city over two years ago by the companies. Without going into detail, it should be noted that any one of these propositions offered a positive solution, which included all the essentials of public ownership and control, and which would ultimately have developed into full and complete ownership for the city, without injury to the existing investment of the companies. These propositions were given such slight consideration that it is apparent a duplication of systems had been predetermined.

Under the circumstances, it is safe to predict that the year 1916 will give us a great object lesson in negative co-operation. Municipal pole duplication is about to re-create the same pole nuisance that existed several years ago, before the companies adopted the present co-operative method of using facilities jointly. This is a matter of vital interest to every member of this league and to every other home owner in this city.

For almost a decade the companies have consistently endeavored to suppress the pole nuisance. How well they have succeeded, is best shown by the fact that 70,000 more poles would be needed for the service given today had the companies not initiated the joint pole scheme, which, aside from the relief of the annoyance to the property owners, has helped to give Los Angeles the most favorable rates of any city of its size in the world. This work is still going on at a normal rate which saves in excess of 1000 poles per month. This saving represents the conservation of many acres of natural forest, which we trust may be put to better uses by posterity.

Over fifty per cent of the distributing lines are located on the rear property lines or alleys. This percentage would be even greater were it not for the fact that it is necessary to maintain many poles on the streets for street lighting purposes, and this being the case, distributing circuits have in many instances been placed on the same poles.

This is the problem which will confront the city also. It will be necessary for the city to build an entirely new street lighting system, and its distributing lines will therefore also be confined largely to the streets. Forty-five thousand poles will be required to adequately cover the city of Los Angeles so that every citizen desiring municipal light and power may be served. This represents an investment for poles alone amounting to over \$900,000. It will cost you and every other member of this league \$5 for the privilege of having another pole in front of your residence; it will cost you annually over \$1 to maintain that pole

in position, and this applies to every other home owner in Los Angeles.

Compare this result with the economies which have been brought about by joint construction. Every time two, three, or four companies join in the use of a common pole, the investment is divided into two, three, or four parts, as the case may be, and the fixed charges are similarly divided so that the consumer derives the full benefit of freedom from unnecessary duplication and useless waste.

The present joint lines have been erected in accordance with the regulations of the railroad commission and the statutes of the state of California. Lawful clearances have been established for the facilities now in use. Joint construction with the city is impracticable, due to the great cost of reconstructing lines which now conform to law. Higher poles would be necessary in all cases. Notwithstanding this, the city will be to great expense in obtaining its legal clearances from existing lines. This is the most difficult problem which the companies have to contend with today. The construction of another distributing system under such conditions is a task which even a private corporation would hesitate to initiate.

The 45,000 poles required for municipal distribution will have to be replaced by a like number in from ten to fifteen years. Including maintenance, interest and depreciation, this represents an annual charge of over \$150,000, which is part of the price the citizens will pay for pole duplication alone, and that is not all. This does not include the crossarms, wires, cables, transformers and fixtures which go to make the sky line of our city hideous.

No logical reason has ever been advanced to support the necessity for this reckless expenditure of public funds derived from a bond issue, which a future generation will be called upon to pay. The public service companies in Los Angeles have been the greatest factors in upbuilding the community. For many years, millions have been brought into Los Angeles for the development of public utilities, and so far, there has not been any compensation for those who have made this possible. That such funds are no longer available for developing the wonderful possibilities of our city and country, is due entirely to the accurate impression which has gone abroad that we are indifferent to the welfare of the investor. Hailed as a benefactor until his funds are irreparably tied up in California industries, he thereupon becomes a malefactor seeking unmerited compensation.

The electric railways of Southern California are recognized as the greatest in the world. Serving a population of less than one million, they have been striving to give us service not excelled in communities with ten times the density of population. Their promoters have built far into the future, and it is due to those who have demanded constant restrictions on the railways that withdrawal of service is gradually taking the place of development. Automobile competition is further curtailing income, taking the choicest business without assuming any share of responsibility to the community as a public utility.

The power and telephone companies likewise have penetrated the remotest sections of this community, so that service is available to a large percentage of the citizens in the city or country.

A curious analogy exists between the jitney bus competition with the railways, and municipal competition with the power companies. The jitneys are taking away the cream of the railway business, and yet it is conceded on all sides that they are operating at a loss. An entire ignorance of economic principles succeeds in maintaining the loss making competition through constant change of ownership of the jitneys. The city will share the light and power business with the power companies, and will be operated at a loss in that it cannot provide for maintenance and depreciation and at the same time take care of its interest and sinking fund requirements, so that the difference will have to be made up by direct taxation. Experience elsewhere has proven that where the municipality enters into competition with a private corporation, it always fails to get a majority of the business.

Every power system has three essential components: the generating system, the transmission system, and the distributing system. None of these is of any service value without the others as adjuncts; nevertheless the city recently proposed to take over forty-five per cent of the Southern California Edison Company's distributing system at a value below its actual cost to reproduce.

"Severance damage" is a term apparently new to the proponents of the city's project. Let us suppose that any or all of the other communities served by the Southern California Edison Company should also decide to condemn a portion of the company's distributing system piecemeal, would there be any severance damage when the company was deprived of all but a handful of consumers, but still retaining a complete generating and transmission system with a readiness to serve to their full capacity?

As an analogy, let us suppose that one of our great daily papers, circulating extensively in Los Angeles and every other town and hamlet in Southern California, should suddenly find itself deprived of the privilege of doing business in Los Angeles City, what would become of its circulation and advertising? Its entire plant and equipment would be practically valueless as a revenue producing unit. We may carry the analogy still further. At a time not very remote, Los Angeles had a daily municipal newspaper. It was well managed. None of the other papers could compete with it in cost to subscriber. It was voted in as a popular necessity. It went out unlamented by a single taxpayer. It was a useless duplication and a needless expense to the citizens. Its functions, being purely local in character, have at all times been taken care of by the privately-owned newspapers merely as incidental to a complete news service.

It has been stated that it is the duty of the city to distribute the power which it will generate. One of the illusions is that duty and desire are synonymous terms. It was the duty twelve years ago to permit the introduction of a second telephone system in Los Angeles. Now, that we have two efficient systems, but higher rates, it becomes a duty to seek to destroy one of the companies by enforcing inter-change of service. Duplication is a duty in one case, a desire in the other. Duplication has never yet been known to offer a reduction in cost to serve. Every unnecessary pole erected in Los Angeles must ultimately be paid for through the customer's meter or by direct taxation.

REPORT ON THE COLUMBIA RIVER POWER PROJECT.

BY L. F. HARZA.

Appendix G—Problem of Flood Control.

Controlling conditions. Under the scheme of head control which has heretofore been assumed, the headwater would be controlled during moderate floods to greater, but during extreme floods to less, than natural elevation. It is therefore established that any scheme of control dam must include a provision for opening it by gates or otherwise, to a capacity of not less than that of the present natural flood cross section at the damsite.

The location tentatively chosen for the control dam: i.e., the bench to the right of the neck at the head of Five Mile Rapids, is now subject to overflow during floods, as may be seen by a comparison of the flood profiles in Fig. 21 (p. 34, Jan. 8, 1916, issue this journal), with the elevations in the topographic map,

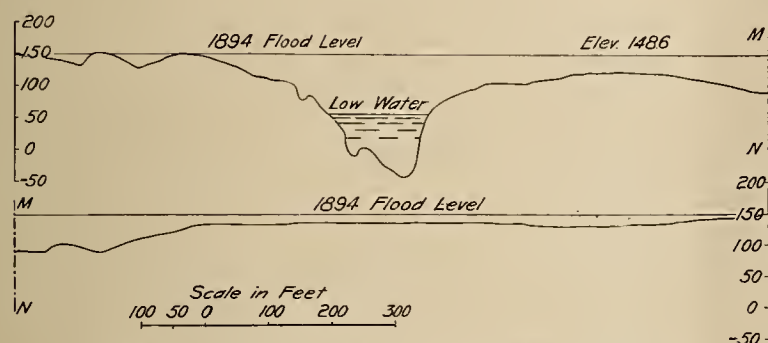


Fig. 33. Cross Section at Dam site during Flood of 1894.

Fig. 9, (p. 394, Nov. 20, 1915, issue). In Fig. 33 is shown a section taken along an irregular route across the river valley, believed to be essentially the natural flood controlling or minimum cross section at the damsite. The total area of cross section during the 1894 flood along this profile was 83,000 square feet, the average velocity therefore about 14.1 ft. per second.

The fall which might be utilized in the passing of floods is limited to the natural fall from the headwater to the place of return of the flood channel to the natural stream bed. In Fig. 7 (p. 394, Nov. 20, 1915, issue this journal) was shown the general proposed layout and in the main channel at or near the upper and lower limits of return of the proposed flood channel are shown two gages, Nos. 2 and 3 respectively. The positions of these gages are also shown in Fig. 21, from which it will be seen that a drop, in 1876 and 1894, of 12 ft. is indicated between the upper river and Gage 2, and in 1903 a drop of 14 ft.

The mean velocity of 14.1 ft. per second in 1894 is represented by a head equivalent of only 3.1 ft. The hydraulic efficiency of the natural channel is therefore very low. This is due to two reasons: The comparatively shallow depth of flow across the rock bench together with its extreme roughness and intersecting cliffs of lava flows, causes a relatively low velocity as compared with that in the main channel. Its fall of 12 ft. is thus

largely used up in friction and the correspondingly large velocity thus necessary in the main channel must require the sacrifice of a greater head. These heads of 12 and 14 ft. correspond to velocity equivalents of 28 and 30 ft. per second respectively. Deducting for the portion of this drop which represents friction loss, it is probable that a velocity of at least 20 ft. and perhaps 25 ft. per second, corresponding to theoretical heads of 6.25 ft. and 9.7 ft., exists in the main channel during floods. The artificial flood channel which would be cut through the right bench would be much more efficient hydraulically and would not for this reason require the entire cross section of 83,000 sq. ft.

Available head. The head which can be utilized was determined by the method shown in Fig. 34, most of the data for which was taken from Fig. 21. The upper curve is the relation curve of discharge and elevation at the damsite as determined by the Corps of Engineers, U. S. A., at Gage 1, shown in Figs. 7 and 9 (their Gage No. 3); the next two curves which run together for high discharges essentially represent the water elevation at the point of return to the natural river bed of the artificial flood channel, the position of these gages being also shown in Fig. 7. It was proposed to design the flood channel for a discharge 20 per cent in excess of that of 1894, or 1,400,000 second feet, without increase of headwater elevation above that of 1894. The upper curve is therefore extended horizontally from "B" to "C," Fig. 34, permitting artificial regulation of headwater along a line such as "AC." The curve of Gages 2 and 3 has also been extended to 1,400,000 second feet. The difference in elevation between Gage 1 and Gages 2 and 3 at this point is 8.1 ft., which has been further reduced to 7 ft. for safety; and this figure has been assumed as the

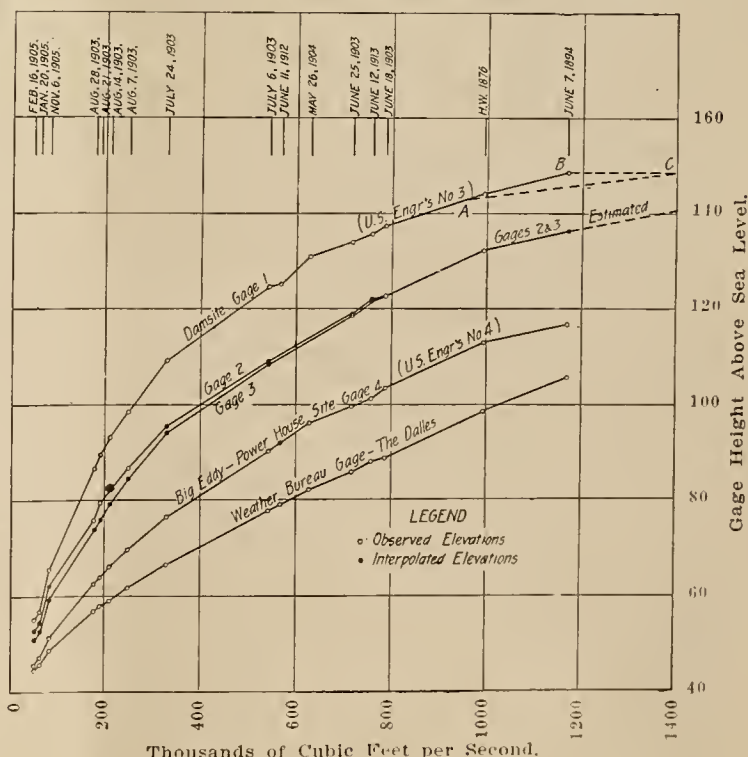


Fig. 34. Gage Curves Through Five Mile Rapids and at The Dalles.

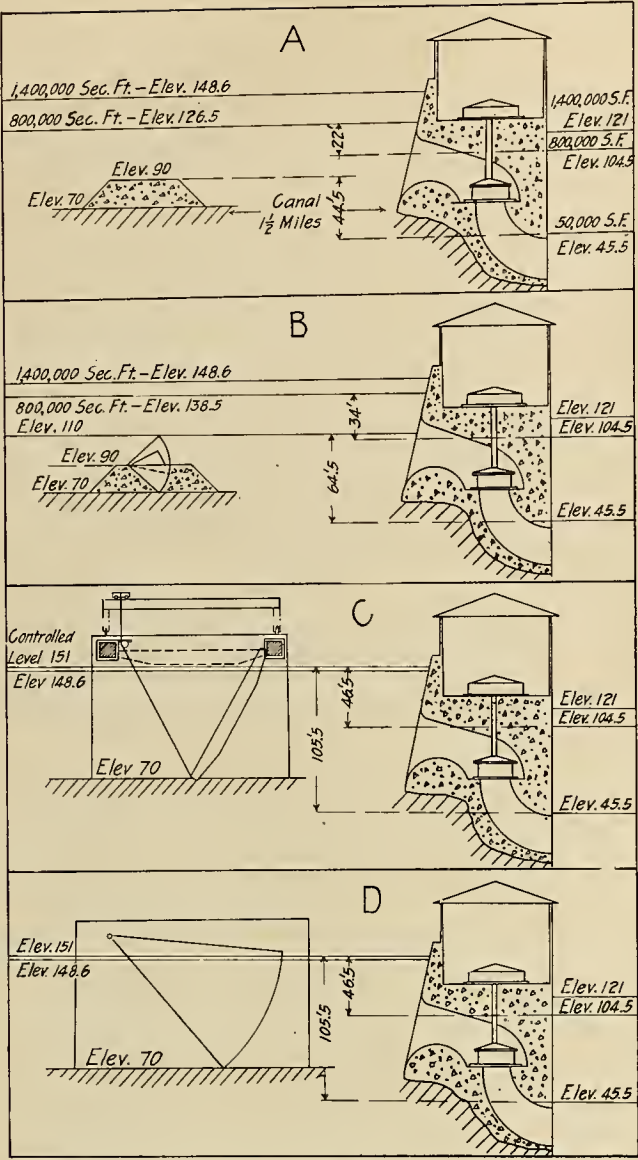


Fig. 35. Alternative Schemes of Development Based upon a Loose Fill Dam.

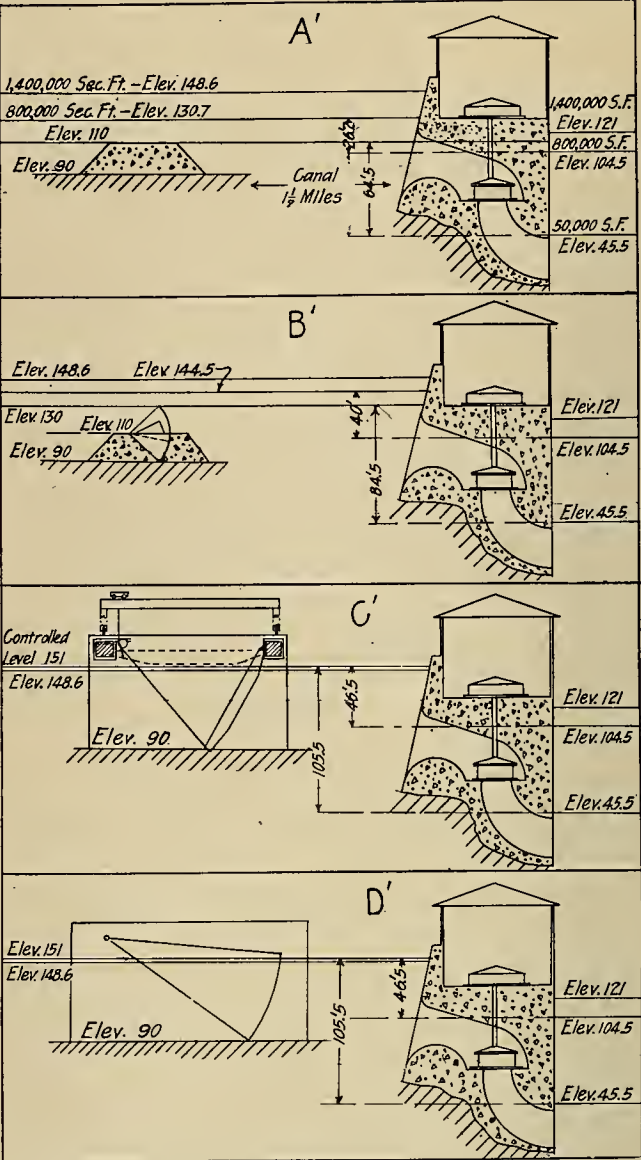


Fig. 36. Alternative Schemes of Development Based upon a Concrete Dam with Gates along the Crest.

available head for the design of the spillway or flood channel.

Alternative projects. The available head has been discussed in its relation to property damage and turbine operation. It is also influenced by the space available for spillway or flood channel and the limitation of feasibility as to both type and size of flood gates. Figures 35 and 36 represent the possible alternative projects as limited by the last named considerations, the former showing the available heads based upon the use of a rock fill dam and the latter upon a concrete dam and the use of its crest for flood gates identical to those used elsewhere.

The first natural assumption is to use, if possible, an overflow spillway designed to pass the maximum flood at the same elevation (148.6) as in 1894. The use of an overflow spillway or weir would require the excavation of a deep flood channel similar to that shown in Fig. 7 and the spillway dam would then be built along the bottom of this channel from the rock fill dam (or across the concrete dam) along the right or Washington shore of the natural river channel until it would meet the wall of the power canal, thus using all available space. A portion of this spillway is shown dotted in Fig. 7 to indicate its location.

The next natural alternative worthy of consideration consists in the use of some form of collapsible crest or "flashboard" on the top of this overflow spillway, to be lowered in time of flood. Such a crest was designed having a height of 20 ft. and is shown in projects B and B'.

The hydraulic conditions are so unusual as not to permit of the accurate design of this spillway for want of experimental data. It would be a submerged weir placed at an angle with the direction of flow, having a fall across its crest of only 7 ft. and a depth of flow in flood time for project A, with rock fill dam, of about 60 ft. and for project A', or with concrete dam, of about 40 ft. The controlled headwater elevations and available heads shown in Figs. 35 and 36 and given in the following table, must therefore be considered as only approximate:

Table of Available Heads.

	At 50,000 Sec. Ft.	At 800,000 Sec. Ft.
Overflow weir, rock fill dam, Project A, Fig. 35	44.5 ft.	22.0 ft.
Overflow weir, concrete dam, Project A', Fig. 36	64.5 ft.	26.2 ft.
Overflow weir, with 20 foot regulating crest and rock fill dam, Project B.....	64.5 ft.	34.0 ft.
Overflow weir, with 20 foot regulating crest and concrete dam, Project B'.....	84.5 ft.	40.0 ft.

An overflow spillway is undesirable in that it does not permit of head regulation during moderate floods. The elevation of crest must be chosen to pass the maximum flood of 1,400,000 second feet without exceeding its natural elevation and useful head is therefore sacrificed at or below the assumed limit of practical operation or 800,000 second feet. This sacrifice at 800,000 second feet is as follows:

Project A.....	22 ft.	Project A'.....	18 ft.
Project B.....	10 ft.	Project B'.....	4 ft.

Flood gates. It is therefore highly desirable that a dam of some form be constructed such that no sacrifice of available head at any stage of the river will be required. Such a dam must necessarily consist of flood gates which when closed, will hold the water up to the limit of practicable head as governed by other considerations, and when opened will pass the assumed flood of 1,400,000 second feet without exceeding the elevation of 1894, or 148.6 ft. at the damsite.

Such gates require long piers, and much of the already small available head would be lost in turning the water through an angle of about 60 degrees, as would be necessary if the gates were to be arranged along the right shore of the channel in the same position as shown in Fig. 7 for the overflow spillway. The gates have therefore been arranged across the available width in a direction nearly at right angles to the direction of flow. Two chief designs of headworks have been made, each maintaining the head under complete control at all times, one by the use of the Camere vertical girder (sometimes called wicket girders) type of gates and the other by a reversed tainter gate. These are shown in Fig. 35 and 36 as Projects C, C', and D, D', respectively. The two types of gates and headworks will be described in the order of their development.

(To be continued.)

Concatenation of motors is now used to reduce the speed of the electric towing "mules" at the Panama Canal from two to one mile per hour. Switches have been installed so that the two main induction motors of each locomotive can be operated in cascade at half the speed for which the machines were designed.

Cobalt plating seems destined to replace nickel plating for many purposes, particularly as it offers greater resistance to corrosion, gives a harder surface and can be deposited much more rapidly, due to the higher concentration and conductivity of the solution. A solution of cobalt sulphate with sodium chloride and boric acid on a cobalt plate can be deposited in one minute as compared to one hour required for nickel.

An electric house heating system has been devised in Sweden whereby a four to a ten room house can be economically heated with off-peak electric power. The house is equipped with the ordinary type of hotwater radiator. Resistance elements in a large heat-insulated tank in the attic bring the water to a high temperature during the night. The hot water flows by gravity through the radiators and piping to a tank in the basement, whence a motor driven centrifugal pump forces the water to the tank in the attic, and the cycle is again repeated.

Vacuum melting of silicon steel increases its ductility and improves its magnetic properties, giving high permeability and low hysteresis loss so that it is well adapted for electrical machinery. Full details are given in Bulletin No. 83, Engineering Experiment Station, University of Illinois.

Ocos loses its electric plant as the result of salvaging the old Kosmos liner Sesostris, which was beached on the coast of Guatemala near Ocos about nine years ago. The chief engineer, who had been left in charge of the ship, supplied electric power to the town from the ship's dynamo. But since the war, prices for steamships have advanced to such a point that it now appears profitable to dig a canal and float the boat back to the sea.

Feed water heaters utilize exhaust steam to raise almost to boiling temperature the water feed to steam boilers, thus preventing the introduction of cold water into the boilers. With the open type of heater the steam is passed directly through the water, while with the closed type the steam passes around circulating water pipes. With the open type the boiler feed pumps are placed between the heater and the boiler while with the closed type they are placed before the heater, thus forcing the water through the heater to the boiler. When the escaping gases from the boiler furnace pass around the feed-water pipes this form of heater is known as an economizer.

Undeveloped potential water power in the United States, according to careful estimate recently presented before the public lands committee of the House of Representatives ranges from 28,000,000 to 35,000,000 h.p. On a basis of 28,000,000 potential h.p. the Government has divided it into groups and states as follows: North Atlantic states, 2,200,000 h.p., or 7.9 per cent; South Atlantic states, 2,300,000 h.p., or 8.2 per cent; the North Central states, 1,700,000 h.p., or 6 per cent; the South Central states, 1,500,000 h.p., or 5.3 per cent; the Western states, 20,400,000 h.p., or 72.6 per cent. This includes the potential horsepower for navigable streams as well as non-navigable streams.

A city's right to nullify a franchise has been affirmed by the U. S. Circuit Court of Appeals at San Francisco. This affirms the decision of the District Court of Washington in the case of the Old Colony Trust Company against the city of Tacoma. The lower court decided the municipality had a constitutional right to nullify a franchise that had been given to the Tacoma Railway and Power Company. The Old Colony Trust Company was trustee for the bondholders of the power company. In 1905 a franchise for twenty-five years was granted to the power company to sell electricity for heating and power purposes. The privilege of selling power for lighting was not given. In 1913 the Tacoma Railway and Power Company, according to the municipality, entered into a contract with the Northern Pacific Railway Company to supply light. When the power company refused to rescind the contract, the Tacoma city council ordered the franchise revoked on the ground that its provisions had not been observed. The Old Colony Trust Company appealed.

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POWER AND GAS

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The leading article of this issue is apparently an argument for the construction of isolated water power plants supplying electric energy for mining and industrial purposes, rather than depending upon central station supply. Such a condition already exists in Norway and Sweden where most of the developments are small capacity, low head plants.

Yet close analysis demonstrates that these are exceptional conditions which do not conform to the conditions usually found in the West. Long distance lines in operation that it is seldom possible for the isolated plant to compete. Here and there in inaccessible transmission lines can be so easily constructed and centralization of power supply affords such economical places where the power can be consumed close to the point of generation a mine or manufacturing plant can best afford to generate its own power, but in the great majority of cases purchased central station power is either cheaper, more convenient or otherwise more satisfactory. The choice of these methods represents a nice problem in engineering judgment.

Strong claims are being advanced for electricity as an agent for heating buildings. A number of working installations have been made in localities where surplus power is available during the period of non-irrigation which closely coincides with the period of greatest cold. The most notable instances are on the Minidoka project of the U. S. Reclamation Service in Idaho, where 2200 volt current is supplied between the first of September and the end of May at one dollar per kilowatt per month, based on the maximum demand for the month.

Notwithstanding the cold winter this exceedingly low rate makes it possible to heat homes and even public buildings with electric heaters almost as cheaply as with coal. Thus the high school at Rupert is heated by air forced through eleven grid resistance units consuming 400 kw. at 440 volts. This installation was designed to heat twenty thousand cubic feet of air per minute from zero to seventy degrees Fahrenheit. The high school at Burley is similarly equipped with grids requiring 762 kilowatts. While the current for these installations costs about fifteen hundred dollars annually, as compared with about one thousand dollars for coal, the saving in operator's wages and building space, the longer life and the greater cleanliness and convenience compensate for the difference.

Much the same conditions exist elsewhere throughout Idaho, likewise in the San Joaquin Valley of California. Due to the fact that electric service for irrigation is not required during the winter months the large surplus of electric energy can be used for heating at a price which the consumer can well afford to pay, as otherwise the company would receive no revenue during the months of no demand.

This, at best, is but a temporary expedient. Within a short time other more valuable uses for the current will be developed in these districts. These higher uses will take precedence over the wasteful use of current. At such prices railway electrifi-

cation becomes possible, electro-chemical plants are developed and gradually this sort of electric heating will be replaced by the systems which utilize and store off-peak current. For these latter systems there is a great future. Heat energy can be stored where the storage of electric energy is not an economic possibility. Ultimately this economic question will be solved by the great law of supply and demand.

Little do engineers realize how many promising careers have been limited to mediocrity because of inability to clearly and forcibly express thoughts by word of mouth or pen. How often does it become necessary for a man to impress his ideas on other men. How frequently, at such times, do engineers find themselves unprepared and forfeit to men of less technical ability, but with greater power of expression. Then is a ready command of the English language indispensable.

It is a sad anomaly that those who have done so much to facilitate communication, whether by railway, telegraph or telephone, should usually be unable to adequately communicate their thoughts to others. Few recent technical graduates can write a letter without making mistakes in spelling and punctuation. Fewer still can write an engineering specification without slavishly copying a set form which, likely as not, perpetuates errors perpetrated by the original writer. The same criticism applies to the preparation of engineering reports.

The responsibility for these deficiencies rests primarily upon the engineering college, where English is neglected in order that more time be available for premature specialization in subjects which the student may never be called upon to apply in practice. Even where instruction in English is prescribed most of the course is devoted to a study of the history of literature and a consideration of poetry instead of teaching the student how to write and talk plain prose. Accurate thinking requires plain writing for its expression.

Yet those whose early education has been neglected in this respect can remedy their defects if they will. The power of written and oral expression, like muscular development, can be acquired by anyone who will try. Like a muscle, it is strengthened by use. Constant practice is all that is necessary.

Writing about what you have done makes you better able to do it again. It clarifies your thought and points out where you are weak. Furthermore the publication of such experiences is the greatest service that can be rendered brother engineers. Mutual interchange of experience is the greatest aid to efficiency and the best preventive of the waste that comes from useless duplication of effort. Think of the time that has been spent in trying to accomplish the impossible—to square the circle and to trisect an angle with rule and compass—because the man who had demonstrated the impossibility either could or would not tell the world.

In fact, the lack of public appreciation, about which engineers complain, is largely due to their failure to take the public into their confidence. This is often as much due to unwillingness as to inability. The engineer is too prone to jealously guard

what he imagines are secrets, whereas if there is any truth in them they are rightfully universal property. The possession of knowledge is a stewardship which can be met only by sharing it with others.

If the engineer would be appreciated he must tell the public of his deeds which are worthy of esteem. This implies neither rushing into print nor indiscriminate talking. It presupposes something to talk about. "The steam that blows the whistle never turns the wheel." Yet whistles have not yet been relegated to the limbo. If the engineer does not blow his own whistle when he has something to blow about, nobody else will blow it for him.

Finally we can be of greater service by honestly telling each other of our failures and learning the lessons from the mistakes than by writing only about our successes. The red flag of danger is as necessary as the green flag of safety. The truly broad man learns from the mistakes of others and is willing that others should learn from his.

While the substitute for the Ferris Bill, as reported by the Senate Public Lands Committee, represents a great improvement over the impossible bill that recently passed the House of Representatives, it is still in need of certain amendments to make it equitable, a few changes to assure the possible investor of the security of his investment. Two defects are so marked as to call for detailed discussion.

One objectionable provision, as it appears in the seventh section, limits contracts for the sale of electrical energy to a period "not to exceed twenty-five years." This is entirely too short a time for the building up of an irrigation project dependent upon the cost of electrically pumped water, or even to justify the establishment of a great manufacturing plant and its workingmen's homes. This is a question which should be left to the lessee, the public service commission and the Secretary of the Interior.

The other objection appears in the eighth section and constitutes the most serious fault in the bill. It gives the Secretary of the Interior the power to specify the rental of federal lands necessary for power development. This discretionary power is capable of abuse and tends to destroy confidence among investors. The charge should reasonably be limited to a fair rental of the land for all purposes and certainly should not exceed twenty-five cents per horsepower year for the power developed and sold by the lessee.

Aside from these two great defects, in one of which the bill is too specific and in the other too general, half a dozen minor amendments should suffice to convert this measure into one which would encourage the development of water power in Western states. While it falls short of placing a premium on hydroelectric development in order to prevent needless fuel consumption, it is so much better than the present onerous restrictions that it would be hailed with joy in the West.

The most notable feature of the bill is its recognition of the necessity of "co-operation between the states, which control the water, and the United States government, which owns the land."

The Importance of Plain Writing

An Improved Water Power Bill

PERSONALS

S. B. Clark, underground engineer Northwestern Electric Company, of Portland, is at Spokane.

F. B. Johnson has been appointed safety engineer for the Pacific Light & Power Corporation of Los Angeles.

F. H. Leggett, Pacific Coast manager Western Electric Company, is spending a few weeks at Seattle.

F. J. Somers of the Century Electric Company of San Jose spent the latter part of the week at San Francisco.

W. S. Graham, manager of the Snow Mountain Power Company at Ukiah, Cal., was at San Francisco last week.

C. V. Schneider of the Electric Supply Company of Sacramento, spent the latter part of the week at San Francisco.

Chas. S. Northcutt, manager of the Modesto Gas Works of Modesto, was a recent business visitor at San Francisco.

I. W. Alexander, editor of the San Joaquin Light & Power Company's magazine, was a recent visitor at San Francisco.

Eph. Doherty, traveling salesman of the American Electric Heating Company of Detroit, Mich., is at San Francisco.

A. K. Baylor, administrative official of the General Electric Company of Schenectady, has returned to the East after spending a couple of weeks on the Coast.

Guy Talbot, president Pacific Power & Light Company, is at New York and Washington, where he will remain about a month.

Kelley Courtwright has succeeded **J. H. Carr**, deceased, as manager of the Valley Electrical Supply Company at Fresno, Cal.

Wm. Hood, chief engineer of the Southern Pacific Railroad, was recently made an honorary member of the Engineer's Club at San Francisco.

E. R. Murray, with the Western Electric Company of San Francisco, has just returned to San Francisco after a successful business trip throughout the San Joaquin Valley.

M. L. Joslyn, president of the Joslyn Manufacturing & Supply Company, Chicago, Ill., and president of the Baker-Joslyn Company of San Francisco, is expected at San Francisco about the first of the week.

E. M. Cutting, Pacific Coast manager of the Edison Storage Battery Company, Orange, N. J., has returned to San Francisco after an extended business trip throughout the Sacramento and San Joaquin Valleys.

A. J. Meyers, Pacific Coast manager of the Wagner Electric & Manufacturing Company, has returned to San Francisco after an extended business trip throughout Southern California.

Guy L. Bayley, having practically completed his duties as chief mechanical and electrical engineer for the Panama-Pacific International Exposition, has opened offices as consulting engineer at San Francisco, specializing on industrial problems.

R. T. St. John, for several years associated with the General Electric Company on the Pacific Coast, has resigned to devote his time to personal interests, having recently been elected secretary of the Harbor Building and Loan Association of Southern California, with offices in Los Angeles.

W. D'A. Ryan, illuminating engineer of the General Electric Company, and for the past year illuminating engineer for the P. P. I. E., has recently left for the East on a business trip and while in Boston will give a lecture to the A. I. E. E. on the exposition illumination and its commercial applications.

Representatives of the J. W. Johns-Manville Company from all parts of the United States were gathered at San Francisco for their annual convention during the past week. Among those present were: **H. R. Wardell**, general manager of the roofing department; **B. C. McClure**, general manager of the purchasing department; **E. L. Cox**, general manager of the

illumination department; **L. R. Hoff**, general sales manager, all of New York, and **R. W. Wade**, **W. H. Rumble**, **Wm. Lichty**, **H. D. Ainslie**, **E. T. Bates**, **W. S. Hennickie**, **L. Brinker**, and **G. Allen**, representing the sales force of the Los Angeles office; **H. J. Pelleod** of Fresno, **H. K. Takabury** of Sacramento, **C. L. Hill** of El Paso, **Sidney Mayen** of San Diego, and **W. S. Greenfield**, Pacific Coast manager at San Francisco, who presided at the convention. More than forty San Francisco salesmen and other representatives were also in attendance.

A dinner was given at the Clift Hotel on last Friday evening in honor of **W. M. Shepard**, before he left the employ of the General Electric Company at San Francisco, for the North to assume his new position as commercial agent for the California Oregon Power Company. Those present were:

Camp, W. E.	King, L. S.	Mixer, R. C.
Delehanty, W. J.	Van Huysen, J. W.	Gallagher, H. J.
Sievers, F. O.	Boyd, F. E.	Harraden, W. L.
Loring, C. A.	Fagan, F. D.	Ross, C. V.
Hunt, G. I.	Hunt, E. A.	Fulton, A.
Alvord, R. M.	Hixson, M. C.	Sage, W. C.
Shreve, E. O.	Kearney, S. E.	Langor, J. J.
Dennis, A. R.	Thompson, A. V.	Kenyon, R. E.
Hood, J.	Paterson, F. W.	Gibson, E. P.
Stanley, H. C.	Davis, Jr., W. J.	Shepard, W. M.
Johnson, C. B.	Jones, A. G.	Heinrichs, M. A.
O'Harra, W. E.	Schnapp, M. H.	Voyer, L. E.
Rhine, M.	Myers, E. C.	Hamilton, F. G.
Gassaway, S. G.		

OBITUARY.

William Woodford Cott, for some time sales manager of the Edison Lamp Works of the General Electric Company at Los Angeles, succumbed to typhoid fever on January 5th at Nashville, Tenn., where he had been associated with the company in a similar capacity.

NEW CATALOGUES.

"A Stitch in Time" is the subject of a readable booklet from James G. Biddle, instrument maker, of Philadelphia, which explains the use of the megger in testing insulation resistance.

Switchboard Structural Devices and Accessories are illustrated and described in Bulletin No. 47750 from the General Electric Company. These include standardized supports for switchboards, busbars and insulators, as well as various forms of terminals, clamps and converters.

MEETING NOTICES.

Los Angeles Jovian League.

The regular weekly meeting of the Jovian Electric League was held at Christophers' Wednesday, February 2d. The program was under the direction of **B. F. Kierulff, Jr.**, president of The B. F. Kierulff Company, who was chairman of the day. After the introduction of guests, and the levying of fines against absent-minded members without badges, the speaker of the day, **Theo. D. Ranouse**, was introduced. His subject, "An Old Man's Dream," dealt with reminiscences of his early childhood, ending with a present-day prophecy of a world-wide peace, through the agency of efficient preparedness. The "Four Apollos," a male quartet, with considerable musical ability, completed the program with a number of entertaining selections. A big Jovian rejuvenation is planned for February 18th, and the various committees are working overtime to make the affair a huge success. The wandering satellites of the various electrical industries without the fold are being gathered together, and a record class is assured.

San Francisco Electrical Development and Jovian League.

The February 2d lunch was another capacity house, as is the rule now-a-days. President Cutting was in fine fettle and the meeting proceeded with dispatch. In response to Mrs. M. C. Sloss' plea that the league members co-operate in the "dollar day" collection for the Associated Charities on February 14th, this movement was unanimously endorsed. **R. F.**

Behan was then introduced as chairman of the day and purveyor of entertainment. The last came first in the form of much appreciated musical selections. Then J. J. Jackson, general attorney for the Westinghouse Electric & Manufacturing Company, after paying tribute to the pioneer spirit which built the West, gave an inspiring talk on prosperity, not based on temporary war business, but due to our splendid advantage among nations. The war business, however, has taught the wisdom of a man's sticking to his own business. The war, likewise, and France in particular, has taught the lesson of thrift and the necessity for a strong middle class. At the conclusion of the talk Mr. Jackson, as well as Mr. Behan, was given a ringing vote of thanks.

Portland Sections A. I. E. E. and N. E. L. A.

The bi-weekly luncheon Thursday, February 3, at the Portland Commercial Club, was opened by a prize contest in which L. R. Elder of the General Electric Company made the nearest guess as to the number of water horsepower filed upon by utilities in Oregon, as shown by the state engineer's records. Mr. Elder guessed 450,000, the actual figures being 456,410 h.p. The record guess on the number of h.p. in Multnomah county was also won by Mr. Elder, with 100 h.p. actual figures being 88 h.p. The prize was an electrical percolator.

Mr. George Purvis of the Hurley Machine Company of Chicago gave a general talk on Electric Washing Machines. He also told how his company always had used the follow-up system and sent out a postal card every nine months to all their customers asking for suggestions how they could improve their machine. They received replies from 10 per cent of the people the inquiries were sent. He also said the best class of customers was in the family where one servant was employed or where the lady of the house did her own work.

Mr. W. L. Goodwin, general sales manager of the Pacific States Electric Company, talked upon "Co-operation as practiced in California between manufacturers, contractors, jobbers and central stations." In this talk Mr. Goodwin told of his experiences in California during the time he was trying to inaugurate the system and the results he had accomplished. In Oregon, there seems to be no such co-operation. "Co-operation is absolutely necessary to preserve the industry for electrical people." The small manufacturer of specialties was generally willing to place his wares in the department stores, hardware stores, and 5, 10 and 15 cent stores, which was absolutely demoralizing in its effect. Attendance 45.

NEWS OF THE IDAHO PUBLIC UTILITIES COMMISSION.

In the matter of the application of the Potlatch Electric Company for approval of its schedule of electric rates in Kendrick, Idaho, the commission tentatively approved the rates.

TRADE NOTES.

Swift & Company will construct a plant at San Diego, Cal., for the production of potash from kelp.

The Wagner Electric Manufacturing Company of St. Louis announces the opening of a new office in the Mills Building, El Paso, Texas, with F. B. Hitchings as local manager. This new office is under the supervision of O. H. Davidson, district manager of the Wagner Company, whose headquarters are in Denver.

Rice culture in California may soon receive a big impetus, as the Department of Agriculture has decided to co-operate with the California State Water Commission during the approaching irrigation season in the study of the possibilities of extending rice growing in the Sacramento Valley. Experimental work is to be conducted near Woodland, Knights Landing, Princeton, Gridley and Biggs.

The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until February 21, 1916, for one 37½ kw. 250/2500 volt motor generator set with switchboard and accessories to be delivered at the navy yard, Mare Island, Cal., consigned to supply officer, naval station, Guam, P. I., also three 2 k.v.a. 2200/110 volt oil-cooled transformers, two triple pole, graded shunt multi-gap lightning arresters and six 50 ampere choke coils, one 56 cell storage battery.

A list of generators and motors that are to be installed at the Hawley Pulp & Paper Mill, Oregon City, Oregon, by the General Electric Company, include a 937 k.v.a., 2300 volt, 3-phase generator; 16 kw., 125 volt, d.c. exciter; bank of three 100 k.v.a. transformers, primary 11,000 volt, secondary 2300 volt; 150 h.p., 3-phase, 2200 volt induction motor; 75 h.p., 2200 volt, 3-phase induction motor. To a bank of 3-50 k.v.a. transformers, primary voltage 2300, secondary 480. From secondary side of 350 k.v.a. transformers, primary 2300, secondary 480 to distributing panel. From distributing panel to 25 h.p., 440 volt, 3-phase induction motor; 22 h.p., 3-phase, 440 volt motor crane rating; 15 h.p., 3-phase, 440 volt induction motor; 5 h.p., 440 volt, 3-phase motor; 333 kw., 265 volt, d.c. generator, to 400 h.p., 260 volt, d.c. motor; 14 kw., 250 volt, d.c. exciter.

ORGANIZATION OF THE LIGHTING BUREAU COMMERCIAL SECTION NATIONAL ELECTRIC LIGHT ASSOCIATION.

Two most enthusiastic meetings of the recently organized Lighting Sales Bureau have been held. This Lighting Sales Bureau was established by the executive committee of the commercial section of the National Electric Light Association. Mr. John G. Learned of the Public Service Company of Northern Illinois, having been appointed chairman. The first meeting was held in Chicago in December, and the second in New York, January 11, 1916. This bureau is planning to carry on work of exceedingly practical value in the promotion of lighting sales of member companies. Its reports and its recommendations will be along practical sales lines, the thought being to help member companies to learn the experience of other companies in the promotion of the lighting business. The work of the Bureau is divided among several committees as follows:

Residence Lighting Committee, F. H. Scheel, Streator, Ill., chairman.—This committee intends to cover this subject at the coming convention in Chicago from the standpoint of securing additional residence customers from new buildings as well as existing buildings.

Advertising Committee, A. K. Young, Toledo, Ohio, chairman.—This committee covers the entire field of display lighting, including flood lighting, store front, outline, roof signs, billboard and bulletin board lighting.

Stores and Public Buildings Committee, S. E. Burrows, Newark, N. J., chairman.—This committee is studying the very important subject with the object of outlining plans for securing additional store and public building lighting.

Municipal and Highway Lighting, Thomas F. Kelly, Dayton, Ohio, chairman.—This important committee will hold a meeting in Cleveland on Friday, January 28th.

Industrial Lighting Committee, O. R. Hogue, Chicago, Ill., chairman.—Mr. Hogue is planning to compile a code of industrial lighting covering small standard lighting units which can be used in this class of work. Mr. Hogue's successful campaign in Chicago, in which he has used standard units of this kind will be reported in full. This code will contain selling arguments for the lighting salesman. It will give data and statistics regarding improving the health and efficiency of employes, the reduction of accidents in industrial plants and the far-reaching effect of good industrial lighting upon the homes of industrial workers.



NEWS NOTES



ILLUMINATION.

BISHOP, CAL.—Bids have been called for the installing of lights in the Lone Pine Lighting District, which was recently established.

RED BLUFF, CAL.—Sealed bids will be received up to February 16th for installing a lighting system on Main street between Hickory and Elm streets.

BAKERSFIELD, CAL.—A. E. Stegeman has completed a survey for a pipe line which the California Natural Gas Company is to extend from Waits to the Kern River Oil Fields and work is to start immediately.

WALLA WALLA, WASH.—J. Davidson, vice-president of the Pacific Power & Light Company, has announced that improvements will be made to the power plant and that continuous electric service will be furnished in the future.

PERRIS, CAL.—A contract for installing 26 additional lights in different parts of the city has been signed. C. F. Backstrand of the Southern Sierras Power Company says the work will be started as soon as the weather will permit.

LOS ANGELES, CAL.—Sealed bids will be received by the board of supervisors up to February 14th for maintaining the system of street lighting in the Bairdstown Lighting District, in accordance with specifications on file with the board.

MARTINEZ, CAL.—Announcement has been made by the Contra Costa Gas Company, that service is to be extended to towns along the water front. On April 1st the company will begin laying mains to supply gas to Port Costa, Crockett and Valona.

TAFT, CAL.—The Kern Trading & Oil Company has completed its 16 mile gas line from the 1 camp on Sec. 1, 32-23, to the McKittrick district. The line is to supply the high thermal unit gas of the Midway to the various leases of the K. T. & O. in the McKittrick field for light as well as fuel, and is also to be used at the pumping stations of the Associated Pipe Line Company.

SAN FRANCISCO, CAL.—The board of supervisors has endorsed the proposed system of lighting Market street. The only drawback to the plan was the refusal of the finance committee to appropriate more than \$10,000 as the city's share of the expense. The Downtown Association, which is responsible for the campaign for better lights for Market street, asked that the supervisors appropriate at least \$14,000 of the \$23,194 necessary for the installation and upkeep of the new system.

TRANSMISSION.

SEATTLE, WASH.—The city council voted to develop the Sauk-Suattle power site, in the government forest reserve, for auxiliary electric power.

HELENA, CAL.—Announcement has been made by F. M. Kerr of Butte, general manager of the Montana Power Company that as soon as possible a preliminary survey will be made looking to the construction of the Holter power plant. Its construction will require 300,000 yards of masonry and 1500 tons of steel. The dam and power plants will cost from \$3,000,000 to \$3,500,000.

AUBURN, CAL.—Another condemnation suit instituted by the Pacific Gas & Electric Company for its proposed new tower line through this county is under way in the Superior Court. The defendants are George Campbell and William Campbell. This suit will be followed by several others. The company is prosecuting such suits in Placer, Sacramento, San Joaquin and Solano counties. Its new tower line will extend from here to San Francisco Bay, where rights of way have been secured.

TRANSPORTATION.

SPOKANE, WASH.—The Spokane Traction Company will accede to the wishes of persons in the northwest section of the city who desire the building of a line from Boone avenue to Broadway on Madella street, if the consent to the construction is granted by the company in Portland, and if the city council grants a franchise.

PASADENA, CAL.—A short line transportation service between Pasadena and Los Angeles is under consideration. Plans will be presented to the city commission and the Pacific Electric Company. The plan is to extend the North Loop track from the present terminus at East Orange Grove and Allen avenues, to connect with the Sierra Madre line to Los Angeles. The line would not be more than a mile long.

FALLON, NEV.—At the annual meeting of stockholders of the Fallon Electric Railroad the old board of directors was re-elected, consisting of C. A. Hascall, president; H. C. Lattin, vice-president; A. E. Wilson, secretary; E. S. Berney, treasurer and manager; A. Bauman, director. Manager E. S. Berney reported that the grading for the road was practically completed as far as Sand Point, a distance of about 25 miles from Fallon.

FRESNO, CAL.—Construction work upon seven miles of extension of the Fresno Interurban Railway Company will be started immediately, according to Lee H. Landis, who is at the Hotel Fresno. The extension will start from the Barton vineyard and reach to Kutner's Colony. That the company will spend \$125,000 in construction work before summer is the declaration of Mr. Landis. Immediately following the extension to Kutner Colony construction work on the line to Clovis will start. This will begin from a point 6½ miles from town on the Kutner Colony branch and the extension will be five miles. This is to be followed by extending the Kutner Colony line on to Centerville, a distance of 12 miles.

TELEPHONE AND TELEGRAPH.

COLFAX, WASH.—The Spring Flat Rural Telephone Company has petitioned the commissioners for a franchise to operate a telephone line from Colfax to the Enos place.

SAN DIEGO, CAL.—An ordinance granting the Postal Telegraph-Cable Company permission to lay its wires and cables along and under certain streets in this city, has been adopted by the city council.

PETALUMA, CAL.—The Pacific Telephone & Telegraph Company intends to spend considerable money in improvements to switchboards, cables, and toll lines in this vicinity. Work has been completed on the Santa Rosa toll lead between San Rafael and Petaluma. Within the next four or five months about \$3000 will be expended in the placing of underground cable at the main office, and re-enforcing the present lateral cable at Third and B streets with 100 pair cable. Over 8000 feet of 100 pair cable will be placed on B street; 2500 feet of 50 pair cable on Main street and 800 feet on East Washington street.

Wanted and For Sale

The rate for advertisements in this column is \$1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue. Replies may be sent in care of the Journal of Electricity, Power and Gas, Crossley Building, San Francisco.

FOR SALE.—Big bargains, 8 substation transformers at about half price. Inquire of A. S. Dewdney, 329 E. 18th St., Oakland, Cal.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

VOL. XXXVI NO. 8

SAN FRANCISCO, FEBRUARY 19, 1916

PER COPY, 25 CENTS

THE MILLION VOLT EXPOSITION TRANSFORMER.

BY A. S. LINDSTROM.

THE SENATE WATER POWER BILL.

THE DIESEL ENGINE COMMERCIAL SITUATION.

BY J. E. MEGSON AND H. S. JONES.

PROBLEM OF COLUMBIA RIVER FLOOD CONTROL.

BY L. F. HARZA.

THE "SILVER THAW" AT PORTLAND.

MATERIALS ADVERTISED IN THIS ISSUE

Batteries

Edison Storage Battery Co.

Boiler Feed Water Treatment

Dearborn Chemical Co.

Conduit

Sprague Electric Co.

Electrical Supplies

Electrical Ry. & Mfrs. Supply Co.
Pacific States Electric Co.

Heating Appliances

Simplex Electric Heating Co.

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Pacific States Electric Co.
Hemingray Glass Co.
Pierson, Roeding & Co.

Motors

Century Electric Co.
Crocker-Wheeler Co.

Oil Switches

General Electric Co.

Oil Circuit Breakers

Westinghouse Electric & Mfg. Co.

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Pittsburg Piping & Equip. Co.
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Southern Pacific Co.
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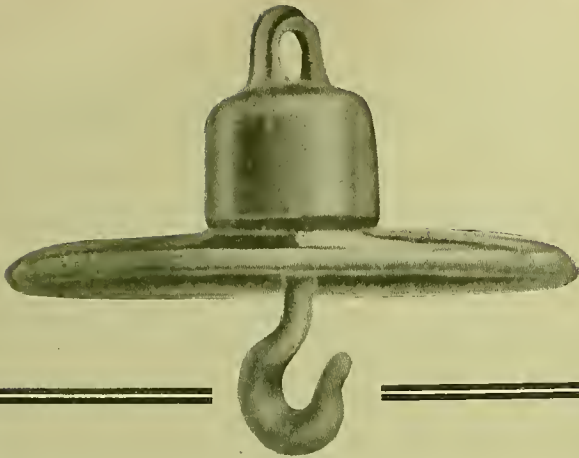
Hurley Machine Co.

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One of the largely used
"THOMAS QUALITY"
High Tension Insulators
 No. 1053. SUSPENSION TYPE
 70000 volts Dry Test
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"Insulator Mortality"

The replacement or renewal of hi-tension disc insulators is the one momentous problem in the mind of the operating electrical engineer today. More has been written on insulator failures in the year just closed than on any other subject. Of vital importance is uninterrupted service.

Prominent engineers have expressed the opinion that the design of this insulator is right and the quality of porcelain has been demonstrated by service rendered. We have samples of every type manufactured, the entire exhibit of R. Thomas & Sons Company at P. P. I. E. having been installed at our store.

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Distributors for the Pacific Coast

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VOLUME XXXVI

SAN FRANCISCO, FEBRUARY 19, 1916

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THE MILLION VOLT EXPOSITION TRANSFORMER

BY A. S. LINDSTROM.

While the million volt transformer at the Panama-Pacific International Exposition excited much popular interest during the closing days of the exposition, the engineer is more interested in what can be learned from these spectacular experiments. They had to do solely with electrostatic phenomena and gave helpful hints on methods of insulation and avoiding corona losses. Before describing the results, a brief description of the apparatus employed is in order.

to hold the entire weight of the primary and secondary windings and paper insulated barrier tubes.

The primary winding consisted of a paper insulated cylinder of copper wire which measured 67 in. long, 23 in. inside diameter, and 28 in. outside diameter. This winding was made of 122 coils, each coil consisting of 44 turns of copper ribbon separated by two thicknesses of 6 mil paper. The copper ribbon was 20 mil by 281 mils, being equivalent to No. 12



Outdoor Network for High Voltage Electrostatic Experiments.

A million volt transformer was especially built by C. H. Thordarson of Chicago, for exhibition at the exposition and to demonstrate a number of theories on transformer construction. It consisted primarily of a 2200 volt primary winding and a million volt secondary winding with a silicon steel core, circulating oil being used as an insulating medium.

It was installed in a metal lined cement pit, placed in a special building erected by the exposition authorities. The building was constructed without nails, bolts running parallel to the million volt wires being used to hold the structure together. The magnetic frame of the transformer was made up of a large number of silicon steel sheets, every fifth sheet being especially separated by paper. The upper and lower horizontal yokes were 120 in. in length and held apart by 40 in. vertical legs. The horizontal yokes and vertical up-rights measured 16 in. by 16 in. in the cross section and were held together by channel and angle irons. The upper yoke angle irons were so constructed

copper wire. The coils were spaced one-quarter inch apart, two connected in series, forming a number of 2200 volt groups, the winding consisting of 61 groups in parallel. The connections between the two coils were connected to a heavy copper busbar running the entire length of the primary winding and thoroughly grounded to the frame and to earth. The grounding of the neutral acted as an electrostatic ground shield to prevent any static disturbances on the 2200 volt winding from the million volt coil.

The main insulation barrier between the low voltage primary and the high voltage secondary was an insulating tube made up of paper impregnated in a hot insulating cylinder under vacuum. This tube was 92 in. long with internal diameter of $29\frac{1}{2}$ in. and an external diameter of $41\frac{1}{2}$ in., thus giving a thickness of 6 in.

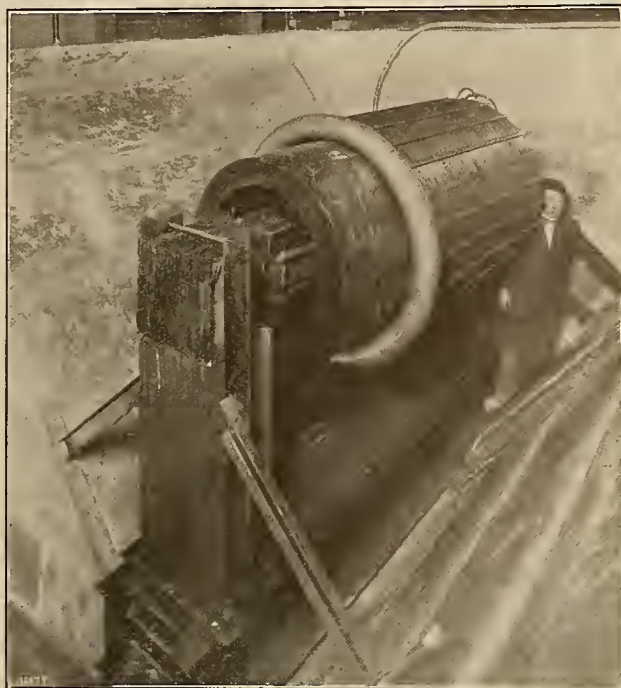
The high voltage secondary consisted of 190 coils, 5300 volts, each connected in series. Each coil was made of 212 turns of aluminium foil, 8 mil by 135 mil

with three thicknesses of 6 mil paper between turns, thus forming a tube 71 in. long, 43 in. inside diameter and 51 in. outside diameter.

These 3 concentric tubes were placed in the metal lined cement pit and immersed in 225 barrels of transformer oil, loaned to the exposition by the Union Oil Company of California.

The high tension lead was brought out vertically through the oil to a height of 11 ft. and then con-

handle of the umbrella. Helium and neon gas tubes became incandescent when within the influence of this field and the positive and negative lines of force could be clearly distinguished by their characteristic glow, the negative ions having a sharp bright line and the positive a broader and duller line. If one of these tubes was held so that it was slightly below the line of the shoulders of a number of observers gathered around, the field of force was lessened and the light



Million Volt Transformer in Vault.



Popular Electrostatic Demonstrations.

nected by means of a 100 ft. horizontal transmission line to a square network of wires 50 ft. by 50 ft. in area and 30 ft. above the ground. This network was made of No. 12 iron wire with 3 ft. square spacing and was suspended by rope insulators from four 40 ft. cedar poles. Wire baskets were so connected at the four points of the electrostatic screen, where contact was made with the insulating rope, as to eliminate any undue stress at the point of contact of rope and wire. A safety rope net was placed 10 ft. above the lowest part of the screen and 20 ft. from the earth so as to protect the public from contact with any part of the wire screen in case the rope supports gave way. This arrangement constituted, in effect, a tremendous wireless telegraph station, the supports between the screen and the earth forming a condenser. The same transmission wire that connected the transformer with the electrostatic screen, was connected through an adjustable horn gap consisting of a $\frac{3}{4}$ in. pipe 15 ft. long, and thence to earth through a 12 ft. jet of water.

With this arrangement many novel effects were brought out in nightly demonstrations of electrostatic phenomena. When a person standing under the screen held his hand in the air the finger tips would glow, and sparks could be drawn from an umbrella, hat or any metal object that was not directly in contact with the experimenter. An automobile drawn up near the influence of the wire screen, gave out sparks $1\frac{1}{2}$ to 2 in. long. The metal parts of an umbrella gave out 2 to 3 in. sparks and at times, with a sudden surprise to the holder, a high voltage stress would puncture the

in the tube became dim until finally extinguished. As the crowd moved away from the tube it would gradually become brighter which indicated the sensitiveness of the helium and neon rare gas tubes. A large vacuum tube $1\frac{1}{2}$ by 30 in. in length likewise became incandescent and round nodes approximately an inch in diameter would form the whole length of the tube when within the influence of this tremendous electrostatic field.

Heavy surges were occasioned in the operation of the transformer. One of these was so great that it broke down the insulating tube between the secondary and primary windings, and at the same time, an arc passed through 24 in. of oil, $1\frac{1}{2}$ in. of plate glass and 1 in. of fine insulating paper. It was estimated that this miniature thunder and lightning display—for it was accompanied by a loud report—represented a surge of at least 4,000,000 volts, with about 450,000 volts impressed on the high voltage secondary and the spark gap discharging a pronounced visual corona so established for 8 ft. along the 100 ft. horizontal main conductor, the diameter being about 10 in. This fact would indicate that standing waves must have existed with potentials of 2 million volts when the electrostatic experiments were being tried out nightly.

Notwithstanding these tremendous voltages the transformer was never put out of commission for more than a few hours at a time by an accident. When the 15 ton transformer was removed from the pit, due to occasional leaks in the metal lining, it was handled readily by the 65 ton locomotive crane.

On one occasion, shortly after the locomotive crane had handled the transformer it became necessary to repair one of the million volt coils, as one of the turns had been displaced. The repair outfit consisted of a few dental tools, a piano spring adjuster

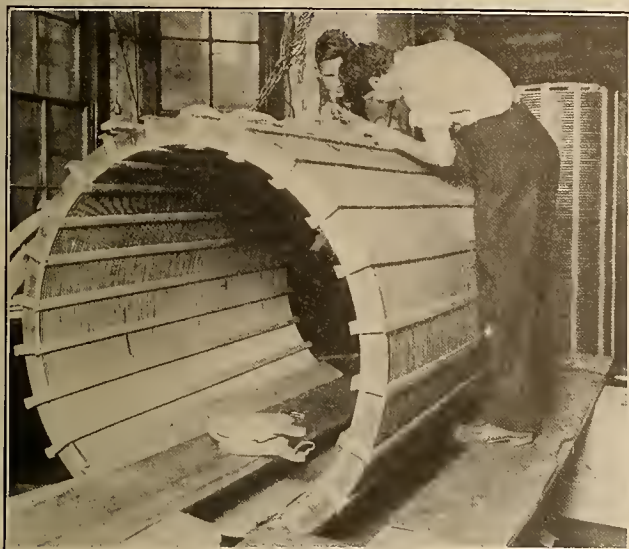
and a small surgical throat lamp, these tools being necessary to reach between the coils and strips of insulating paper between the turns. Small dental magnifying and straight mirrors were used to locate the trouble.

As has already been noted, the wire netting was supported by ropes upon which electrostatic shields were mounted. This rope was first impregnated with hot paraffin and while still warm was dipped in hot tar which formed a smooth coating over the outer surface of the rope and filled up the pores. This effective-

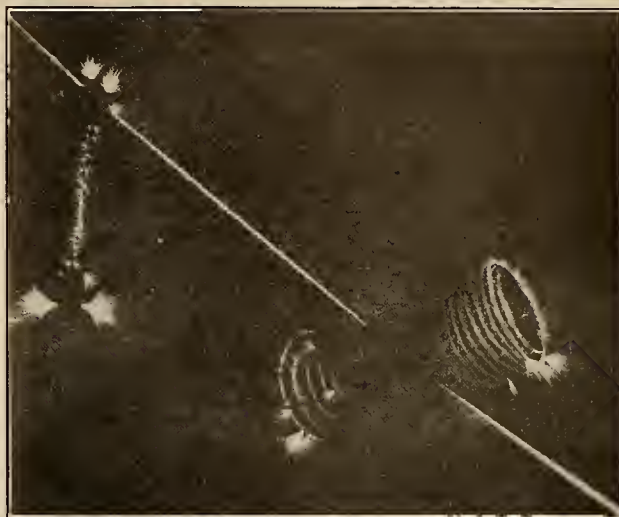
rope being thoroughly impregnated so as to eliminate all moisture.

Electrostatic wire basket shields were located where the insulating rope made contact with the million volt wire. These shields were spread over the insulating rope a distance of 16 in., clearing the rope fully 8 in., which distributed the stress away from the rope, thereby avoiding the burning of the rope where it made contact with the line conductor.

A new-type of high voltage transmission line conductor was designated, which was, unfortunately, not



Connecting Coils.

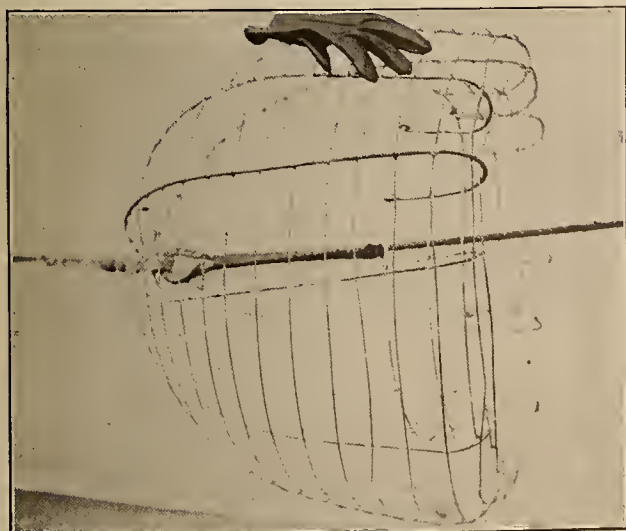


Corona Effects on Wire and Basket.

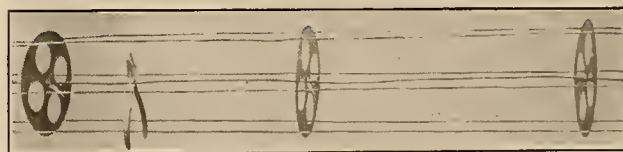
ly prevented the entrance of moisture, even during the heavy rains which occurred while the experiments were being conducted. It is quite interesting to note that the rope supports which were used to take up the slack in the safety rope net, were burned off near the point of support. These small supports consisted of Stockholm tar ropes which for ordinary wireless work would be quite sufficient as insulating supports. The electro-static stress was so strong that it caused these ropes to burn off while the heavy million volt net supporting ropes held without any signs of burning, due, first, to the electrostatic shield where the rope came in contact with the wire, and, second, due to the

tried out in connection with the million volt transformer. This line conductor was to be made up of a number of wires running parallel and held apart by a metal disc 5 in. in diameter, and supported every 5 ft. by a much larger conducting wire threaded through the center of the disc. It is quite possible that this new line conductor will greatly eliminate corona and dampen surges so common on the transmission lines of today, the surges being dissipated in a great number of local short circuits which form between the heavy center supporting wire, out through the discs and along the small outside wires which are held apart by the disc.

From these experiments it has been proven that



Wire Basket Shield.



New Form of Line Conductor.

it is quite possible for this type of bare ribbon conductor and paper insulated transformer construction to be applied to regular power distributing systems. The expense of tapping a 33,000 volt distributing line for 50 kw., would be less than \$695. This includes the taps from the high tension line the fused-switches and the installation of the transformers complete on a two-pole supporting structure up to the 110-220 or 440 service wires, the two-pole structure being set between the towers or poles of the transmitting line. This new transformer construction is provided with heavy rings for the inside and outside of each coil, which will

allow in cases of extraordinary high surges, the arcing between coils thereby blowing the fuses and clearing the transformers from the line.

From the number of tests made, the windings are not affected in the least and the transformer is ready for service on replacement of fuses. There will not be any interruptions on the main transmission line, as each installation will take care of its own troubles and the multiple series windings on these transformers are provided with grounded electrostatic shields, thereby protecting the property or lives of the consumers. This extends the range of transmission with such voltages and small consumers may be served in isolated sections, which will allow for a greater reduction of cost for lines and equipment.

Such a system could be greatly extended and will make possible the extension of power lines through sections of country that are now prohibitive on account of high cost of tapping and the great danger of consumers' lines being charged with high voltages.

On the last night of the exposition the transformer conductor wire was connected to ground through a $\frac{3}{4}$ in., 70 lb. pressure stream and this resulted in a very effective and beautiful display, as the stream of water was quite luminous with corona showing very distinctly. The surges must have been tremendous on the transformer as bolts of fire shot in all directions under the oil and literally chewed the end of the fibre pieces and that part of the paper tube which was directly under these pieces. At no time during this last night's test did the coils show signs of breaking down, which goes far to show the practicability of this construction being adapted to regular high voltage power work.

This 15 ton, thousand kilowatt, million volt transformer has been returned to Chicago at which place Mr. Thordarson proposes to set it up in connection with a number of very important experiments which he expects to conduct during the spring and summer months. Due to the very short time remaining after the arrival of the transformer at the exposition, it gave very little opportunity to carry on the research work which was proposed during the early part of the exposition, but now that the transformer is at Chicago this work, in addition to other experiments, will be carried on without taking up time for public demonstrations.

Prohibiting capitalization of power sites acquired by lease under the terms of the Ferris Bill would meet the requirements of those supporting the measure and remove the objections of those opposing it.

Maintenance of resale prices is endorsed by the majority of the special committee of the Chamber of Commerce of the United States. A properly regulated system of price maintenance on identified merchandise puts the emphasis in competition on quality and service and also provides adequate protection against extortion. It provides an incentive to invent and devise new products and serves to prevent monopolistic control of production processes by powerful distributors. It preserves individual enterprises and best serves public interest. The Chamber's board of directors has voted that the report be submitted to referendum.

WESTERN PRE-EMINENCE IN HYDROELECTRIC DEVELOPMENT.

A large part of the report of O. C. Merrill, chief Engineer of the U. S. Forest Service on "Electric Power Development in the United States and Concentration in Its Ownership and Control" (as furnished to the U. S. Senate by the Secretary of Agriculture) is devoted to hydroelectric conditions in the West.

The minimum potential water power resources of the United States are given as 27,943,000 h.p., and the maximum as 53,905,000 h.p. Over 72 per cent of this is found in the Mountain and Pacific states. Nearly one-half of the total or 42 per cent is found in the three states, Washington, Oregon and California. Of the water powers within the National Forests, 99 $\frac{3}{4}$ per cent are found in the Western states, and these powers amount to 42 per cent of the minimum and 43 per cent of the maximum estimated power resources of those states.

The total primary power under development in the United States in 1912 in commercial and municipal central stations, street and electric railways and in manufacturing plants, as estimated and reported for the year was 30,448,246 h.p., 22.9 per cent of this amount was used in commercial central stations—the public utility business. Municipal stations had 1.8 per cent and electric railways 12.1 per cent. Nearly two-thirds of the total or 63.2 per cent was used in manufactures.

Sixteen per cent of the total primary power in 1912, or 4,870,320 h.p. was water power of which nearly one-half was used in commercial central stations.

The reported and estimated steam installation for the United States in 1912 was 24,339,819 h.p., 80 per cent of the total power from all sources. Two-thirds of the steam power was used in manufacturing; about one-fifth in commercial central stations, one-eighth in street and electric railways and less than 2 per cent in municipal stations.

In the eleven Western states included within the Pacific and Mountain groups, primary power installation from all sources and for all uses increased 240 per cent from 1902 to 1912 or more than two and a half times as rapidly as in the remainder of the United States. In primary power equipment per capita the Western states during the same period added nearly twice as much to their total installation as the remainder of the United States and had an installation at the end of the period one-third greater than for the remainder of the United States. This comparison includes primary power used directly in manufactures, 94 per cent of which is found in the Central and Eastern states.

If a comparison is made of the development of electric power in the Western states and the remainder of the United States, it is found that while primary power employed in the electrical industry increased 226 per cent in the remainder of the United States, in the ten years 1902 to 1912, it increased 440 per cent in the Western states, or nearly twice as rapidly, while the development per capita in the Western states in 1912 was two and a half times as great as in the remainder of the United States.

If water power be considered apart from all other sources of power, the Western states are found to

occupy a still more commanding position. While water power development in the remainder of the United States increased 98 per cent from 1902 to 1912, it increased 451 per cent in the Western states or more than four and a half times as rapidly. In installed water power per capita the Western states in 1912 had more than four times as much as the remainder of the United States.

An examination of the data collected since the census of 1912 shows that the Western states are still maintaining their commanding position in power development. Primary power installation in the electrical industry in the Western states has increased nearly 47 per cent in the three years since 1912. The average annual increase has been 296,000 h.p. as compared with 191,000 for the five years 1907 to 1912. Three-fourths of the total increase is water power, in which the average annual additions for the last three years have been approximately twice as great as the average for the preceding five years.

Of the 1,800,000 water horsepower developed in the Western States in 1915, 30 per cent is in plants occupying National Forest lands with some part—power house, water conduit, or diversion reservoir—of the immediate generating plant.

In addition to the operating plants, there are now under construction on the National Forests hydroelectric plants with an estimated capacity at minimum stream discharge of 123,000 h.p. Outstanding final permits authorizing the occupancy and use of National Forest lands for hydroelectric plants, the construction of which has not yet started, aggregate 420,000 h.p., and preliminary permits, maintaining the priority of applicants while surveys and investigations are being conducted, aggregate 354,000 h.p.

THE SENATE WATER POWER BILL.

The Ferris water power bill, as passed by the House of Representatives, was struck out in its entirety as reported to the United States Senate and an amendment reported on January 25, 1916, whose more important provisions are given in extended summary as follows:

The Secretary of the Interior is authorized, under general regulations to be fixed by him, to lease any part of the public lands of the United States for a period of fifty years, for the purpose of constructing, maintaining and operating works necessary to the development of hydroelectric power, which leases shall be irrevocable except as herein provided, but which may be declared null and void upon breach of any of their terms.

The Secretary may grant preliminary permits for a period not exceeding one year; provided, that no lease shall be granted until the applicant has complied with the requirements of the laws of the state, states, or territory wherein said project is to be located, providing for the appropriation of water to develop or generate the electrical energy intended to be generated by applicant's proposed project.

In case of the development or use of power in a territory, or in two or more states, the regulation and control of service and of charges for service to consumers is conferred upon the Interstate Commerce Commission.

"Sec. 5. That upon not less than three years' notice, the United States shall have the right upon the expiration of any lease to take over all the properties which are dependent in whole or in part for their usefulness on the continuance of the lease herein provided for, which may have been acquired by any lessee under the provisions of this Act,

or the right to take over, upon mutual agreement with the lessee, a severable and complete unit of any such power system, upon condition that it shall pay in a lawful warrant drawn on the Treasury of the United States, or otherwise, before taking possession the fair value of such property, such value to be determined by mutual agreement between the Secretary of the Interior and the lessee, and, in case they cannot agree, by proceedings instituted in the United States district court for that purpose; provided, that such fair value shall not include or be affected by the value of any public lands, rights of way, franchises, or other property leased or granted under this Act by the United States, or by the good will, or prospective revenues."

In the event the United States does not take over the properties, the Secretary is authorized to lease the properties of the original lessee to a new lessee upon such terms, under such conditions, and for such periods as applicable state or federal laws may then authorize, and upon the further condition that the new lessee shall pay for the properties as provided in section five of this Act.

"Sec. 7. That where the public interest requires or justifies the execution by the lessee of contracts for the sale and delivery of electrical energy for periods extending not to exceed twenty-five years beyond the fifty-year period herein named, such contracts may be entered into upon the approval of the public service commission or similar authority in the state, and upon the approval of the Secretary of the Interior."

"That for the occupancy and use of lands and other property of the United States permitted under this Act, the Secretary of the Interior is authorized to specify in the lease and to collect charges or rentals for all land leased, which charges or rentals may in the discretion of the Secretary be measured by the power developed and sold or used by the lessee for any purpose other than the operation of the plant, and of the proceeds fifty per centum thereof shall be paid by the Secretary of the Treasury after the expiration of each fiscal year to the state within which the hydroelectric energy is generated and developed. The remaining fifty per centum shall be paid into, reserved, and appropriated as a part of the reclamation fund." Leases for the development of power by municipal corporations for municipal use shall be issued without rental charge and leases for development of power not in excess of twenty-five horsepower may be issued to individuals or associations for domestic, mining, or irrigation use without charge.

A "wire-your-home" campaign is to be co-operatively conducted throughout the country from March 15 to April 15, 1916, under the auspices of the Society for Electrical Development. It is stated that not 8 per cent of the homes in this country are wired for electricity and that not 20 per cent of the houses on the existing lines of the central stations have electric service.

Heat transmission through boiler tubes is accomplished by radiation, conduction and convection, the last being the most important in modern steam boilers. As the result of a series of investigations Henry Kreisenger and J. F. Barkley conclude in Technical Paper 114 of the U. S. Bureau of Mines that the temperature of the boiler tube is within 10 to 20 degrees C. the same as that of the boiler water. As long as the heating plate is free from scale, oil or other deposits the metal of the boiler tubes can not be overheated, even though the boiler is worked at several times its rated capacity.

THE DIESEL ENGINE IN PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

Commercial Situation.

The commercial situation of the Diesel Engine is unique, for economical and reliable as the engine is, it will not answer, economically, for all possible needs. The matter of first cost and interest on this fixed charge, together with the retirement of the principal by depreciation or placing a certain sum aside to retire the whole cost of the installation in a given number of years all must be given their full consideration. To call the Diesel engine a "cure-all" is a mistake and it hurts the entire Diesel situation. If after making an extravagant statement the facts prove otherwise the engine and engines as a whole are discredited. Fuel economy is not the whole story in the economical generation of power, for the matter of fixed charges and the relative cost of coal and oil must be weighed impartially. It is questionable if the Diesel is suitable to a territory served by an electric transmission system having a diversified load factor composed of many different industries with maximum demands for power at different times of the day and at different times of the year. Such a system can offer inducements of low rates to the character of load to which the Diesel is most suited that need careful consideration. In certain industries where the load factor is high or the ratio of the average load to the maximum demand is high, such as with ice plants where the ice machines are operated 24 hours per day over the large part of the year, the Diesel engine shows its superiority and can compete with any type of power and show a saving.

A simple example can be cited. Suppose an ice plant having a capacity of 50 tons of ice in 24 hours is considered and the cost of power only is analyzed, the engine of approximately 150 or 160 h.p. will cost about \$12,000 set up ready to operate. Let interest and depreciation be figured at 13 per cent per annum which is enough to retire the whole cost in ten years. This 13 per cent amounts to \$1560 per annum or \$4.33 per day. To this must be added the cost of fuel, considering that the engine is of the four-stroke-cycle type and is delivering its full 160 h.p. for 24 hr. each day. The fuel consumption is .41 lb. per b.h.p., or $.41 \times 160 \text{ h.p.} \times 24 \text{ hours} = 1574 \text{ lb.}$ Assuming that a barrel of oil costs \$1 and weighs 315 lb. the number of barrels will be $1574/315$ or approximately five barrels, or \$5 per day for fuel. Lubricating oil may be guaranteed to be 1/10 of a gallon per hour, at a price ranging from 30 to 40 cents per gal. This will amount to $24 \times .40/10 = 96$ cents per day. In an ice plant it would be difficult to justly apply the cost of labor exactly where it belongs. If the ice machine were operated by electric motors the cost of labor would be as great as if the plant were operated by the Diesel engine and less with the Diesel engine than with steam driven ice machinery. For convenience let us divide the cost of labor in half, charging half to the power and half to the actual manufacture of ice. There would be required in such a plant as we are considering a chief engineer and two assistants, the chief taking at least a part of the 24 hour operation for his watch, salary of the chief engineer \$1500 per year or \$125

per month, and two engineers at \$100 per month, or a total labor charge of \$325 per month, or \$10.83 per day, a half of which, or \$5.42 to charge against the cost of power. A charge must also be made for engine room repairs, such as new valve packing, gaskets, springs, emery, etc., of \$150 per year or approximately 50 cents per day.

To recapitulate: Cost per day of 24 hours,

Interest and depreciation	\$4.33
Fuel	5.00
Lubricating oil .....	.96
Labor	5.42
Sundries .....	.50
Total	\$16.21

The output of this plant is 50 tons of ice per 24 hours, making a cost per ton of ice for power 32 cents, including all charges.

Comparing this with an electric motor driven plant using the same size ice machine it would require a 160 h.p. motor with an input of 133 kw., assuming 90 per cent motor efficiency, or 3200 kw.-hr. per day of 24 hours. At 1 cent per kw.-hr. this would amount to \$32.00; at 1/2 cent per kw.-hr. \$16 per day. To this must be added \$5.42 per day for labor, making \$37.42 and \$21.42 respectively, the total cost of power per day. This shows the saving by using a Diesel engine with this type of service amount to \$21.20 per day with current at 1 cent per kw.-hr. and \$5.20 with electricity at the 1/2 cent rate.

If, however, the yearly load factor should be only 50 per cent, or in other words the plant should be run for only six months and shut down completely for the balance of the year the apparent Diesel saving would be materially reduced, for $\$16.21 \times 182$ days of operation = \$2950 cost during the time the plant is in operation, but during the balance of the year the interest and depreciation continue and there must be in addition a charge of $\$4.33 \times 182$ days or \$790 fixed charges, making a total of \$3740 per year. While with electric power the cost would be entirely proportionate to the number of days' operation, the fixed charges on the electrical apparatus, which would cost approximately \$1000, being wholly inconsiderable. With power at 1 cent and 1/2 cent per kw.-hr. the cost of power would be $\$37.42 \times 182 = \6810.00 and $\$21.42 \times 182 = \3900 respectively.

The above gives a clear conception of the great effect of load factor on the total cost of power. In other words, fixed charges, interest, depreciation, insurance and taxes go on day and night regardless of whether the plant is being operated or not. A far more marked example may be assumed where labor joins fixed charges and must be retained whether or not the apparatus is doing the full useful work, for instance, in an electric light plant where 24 hr. service is maintained and during part of this time but an exceedingly small load is carried.

In comparison with a steam turbine the Diesel engine will cost considerable more to install, but the total cost of operation, including fixed charges labor, fuel, lubricating oil and maintenance may be considerably less with the Diesel if the load factor is between 25 per cent and 50 per cent.

The following comparison is interesting: Assume a plant consisting of one 200 kw. unit and one 400 kw. unit, a total capacity of 600 kw., having a load factor of 25 per cent, oil to cost \$1 per barrel. The steam turbine plant erected would cost approximately \$50,000 while the Diesel engine would cost \$73,000. These costs would include building and all necessary apparatus in connection with each of the installations. Operating at 25% load factor the average load per hour would be equivalent to 125 kw. or the load per year would be 125 kw. \times 365 days \times 24 hours, or 1,100,000 kw.-hr. A steam turbine plant of this size may be assumed to develop 190 kw.-hr per barrel of oil, while a Diesel engine plant will develop 100 kw.-hr. for every 9 gal. of oil, or 466 kw. hr. per barrel. The number of barrels per year for the steam turbine will be 1,100,000/190, or 5800 barrels; for the Diesel engine the consumption per year will be 2360 barrels. The fixed charges of 14 per cent on the installation cost on both Diesel and turbine plant, including the boilers, the life of the turbine plant being equal to the life of the Diesel engine, will amount to \$7000 per annum on the steam turbine plant and \$10,220 per annum for the Diesel engine, the total of fuel and fixed charges in the case of the turbine being \$5800 and \$7000 = \$12,800 per annum. With the Diesel engine fuel cost \$2360 in addition to \$10,220 = \$12,580. The wages in the Diesel engine plant will be less than those in the steam turbine plant but the lubrication of the Diesel engine will be slightly in excess of that of the steam turbine. The maintenance, including boiler and turbine, will be greater on the steam plant than on the Diesel engine. The cost for water on the steam plant will be in excess of that of the Diesel engine and it would be difficult in any ideal case as we have assumed, to compare any of these figures, as they so greatly depend upon the locality of the plant, but neither type of prime mover will have any distinct advantage over the other in these regards.

From the above comparison of the cost of fuel and fixed charges the Diesel has so slight an advantage over the steam turbine at 25 per cent load factor that the case alone would not indicate the choice of prime mover. However, as the load factor increases the advantage of the Diesel becomes more apparent and with 50 per cent load factor the following is the result:

The fuel cost of the steam turbine.....	\$11,600
Fixed charges	7,000
Total	\$18,600
With the Diesel, fuel charge.....	\$ 4,720
Fixed charges	10,220
Total	\$14,940

This is a saving of approximately \$4000 per year over the cost of operation of the steam turbine plant. It will be noted that the fixed charges remain constant and the fuel charges increase, making the Diesel continue to show an economy as the load factor increases and even as it decreases between from 50 per cent toward 25 per cent the advantage will still be with the Diesel. At the 50 per cent load factor it will be noted that the \$3600 per year saving represents almost 5 per cent on the total cost of the Diesel installation or the saving on the Diesel would return the difference in cost over a steam turbine plant in approximately six and one-half years.

It will also be noted from this analysis that the advantage of the Diesel increases with an increase of price of oil, for the item of fuel consumption would increase in each case for both the steam turbine and the Diesel, but more so with the steam turbine where the fuel consumption is at a greater rate.

But there enters here the consideration of the consumption of coal, so again the situation must be looked into for the special locality of the proposed installation. All problems of the installation of a Diesel engine revert to fixed charges or the value of the money invested, and in each case must be analyzed on its merits. Where oil is expensive and coal cheap another problem presents itself and again the load factor will undoubtedly be the determining issue. In a comparison with a steam plant using Corliss engines the Diesel can show a saving at lower load factor than when compared with steam turbines, although the fuel consumption for a steam engine plant may be slightly better.

Plant Load.

	Time.	Average Load.	Total Load.	
A.	1 a.m. to 5 a.m.	90 kw.	360 kw.-hr.	
B.	5 a.m. to 7 a.m.	110 kw.	220 kw.-hr.	
C.	7 a.m. to 8 a.m.	220 kw.	220 kw.-hr.	
D.	8 a.m. to noon	170 kw.	680 kw.-hr.	
E.	noon to 1 p.m.	50 kw.	50 kw.-hr.	
F.	1 p.m. to 5 p.m.	170 kw.	680 kw.-hr.	
G.	5 p.m. to 6 p.m.	300 kw.	300 kw.-hr.	
H.	6 p.m. to 9 p.m.	150 kw.	450 kw.-hr.	
I.	9 p.m. to 11 p.m.	110 kw.	220 kw.-hr.	
J.	11 p.m. to 1 p.m.	100 kw.	200 kw.-hr.	
			3380 kw.-hr.	Per av. day, 24 hr.
			Peak load say 315 kw.	

Diesel Plant.

Diesel Engine Plant, consisting of 2-240 b.h.p. Diesels, each with a 160 kw. direct coupled generator.

Pe-riod.	Engines run-ning.	Load on each kw.	Fuel per kw.-hr. lb.	Fuel Gal. per 100 kw.-hr.	Total fuel gal.	Engine hr.
A.	1	90	.64	8.9	32.0	4
B.	1	110	.62	8.6	18.9	2
C.	2	110	.62	8.6	18.9	2
D.	2	85	.65	9.1	61.8	8
E.	1	50	.83	11.6	5.8	1
F.	2	85	.65	9.1	61.8	8
G.	2	150	.62	8.6	25.8	2
H.	2	75	.68	9.5	42.7	6
I.	1	110	.62	8.6	18.9	2
J.	1	100	.63	8.8	17.6	2
					304.2	37
Add 8 per cent for ordinary conditions.....					24.3	2.5
					328.5	39.5
					(Gal. fuel per day.)	(Call 40 hr.)

Fuel oil at \$1.50 per bbl. delivered, \$150/42 3.67c gals., or \$12 per day.
Labor—1 man at \$100 mo.; 1 at \$80; 1 at \$60 = \$240 mo. = \$8.00 per day.
Lubrication—1¼ pints per engine hr. (40 eng. hr.) = 6¼ gal. per day. At 32c per gal. delivered = \$2.00 per day.

Water—At 65° to 75° F. = 1500 gal. per eng. hr. = 60,000 gal. per day. Cost of pumping—2c per 1000 gal. = \$1.20 per day.

Maintenance—\$300 per annum per engine.
25 per annum per generator.
\$325 \times 2 = \$650, all running 24 hr. day (48 eng. hr. day). Actual only 40 hr. per day.
 $\frac{650}{365} \times \frac{40}{48} = \1.50 per day.

Operating Expenses—Diesel Plant.	Per day.
Lubricating oil	\$ 2.00
Labor	8.00
Fuel	12.00
Water (pumping cost)	1.20
Supplies .....	.50
	\$23.70 or .702c per kw.-hr.
Maintenance	1.50
	\$25.20 or .746c per kw.-hr.
Total operating expense per annum, \$25.20 \times 365 = \$9200.	

Plant Cost—2 Diesels and standard equipment; Piping and Sun-dry; 1 Oil Storage Tank—12,000 gal.; 2 Generators; 1 Switch-board; Station Wiring; Foundations, 120 yd.; Erection. Approximately, \$41,400.

Interest, depreciation, 13 per cent = \$5382 per annum = \$14.77 per day.

Operating \$25.20
Fixed charges 14.77

Total cost per day \$39.97

Or, $\$39.97/3380 = 1.18$ cents per kw.-hr total expense.

Steam Plant.

Consisting of 2-200 I.H.P. compound condensing Corliss engines, each with 140 k.v.a. generator; 100 r.p.m.; 3-100 h.p. boilers.

Total constant loss, 45 I.H.P. each engine due to mechanical efficiency of engine, generating efficiency, including friction and windage losses.

Period.	Engines running.	Load in elec. h.p.	I.H.P. (El. H.P. and 45 h.p. loss).	Engine hr.	H.P. hr.	Total dry steam to engines.
A.	1	120	165	4	660	9510
B.	1	147	192	2	384	5530
C.	2	295	385	1	385	5540
D.	2	227	317	4	1268	18250
E.	2	67	157	1	157	2720
F.	2	227	317	4	1268	18250
G.	2	402	492	1	492	7330
H.	1	201	246	3	738	11000
I.	1	147	192	2	384	5530
J.	1	134	179	2	358	5160

Test conditions 6094 88820

Add 8 per cent for ordinary conditions 7100

95920 =

15.75 per hp. hr.

Add 3 per cent leakage and condensation, 10 per cent auxiliaries and oil burners 12480

Total steam for boiler 108400 (Per day)

Fuel—Actual evaporation, 121 lb. water per, lb. fuel oil.

Fuel per day— $108000 \div 121 = 9000$ lb. = 1250 gal. (3.85 times as much as Diesels).

Fuel at \$1.20 per bbl.—2.86c per gal. = \$35.75 per day.

Labor—2 licensed engineers at \$125 mo. each; 2 oilers at \$2.00 day each; 2 firemen at \$2.00 day each—\$490 mo. = \$16.33 per day.

Water—Boiler feed taken from condenser.

Condensers taking 25 to 1 condensing water.

95920×25

= 288,000 gal. per day.

8.3

At 2c per 1000 gal. pumping cost = \$5.76 day.

Maintenance—Boilers 200 h.p. running at

\$1.50 per h.p. \$300 per annum.

Auxiliaries 125 per annum.

Engines and generators 175 per annum.

\$700 = \$1.92 per day

Operating Expenses—Steam Plant—

Labor \$16.33 per day.

Fuel 35.75

Lubricating oil 1.37

Water 5.75 (pumping cost)

Supplies75

\$59.96 \div 3380 = 1.77c per kw.-hr.

Maintenance 1.92

\$61.88 \div 3380 = 1.83c per kw.-hr.

Total operating expense per annum $\$61.88 \times 365 = \$22,600.00$

Comparison—Annual operating expenses, Diesel \$ 9,200.00

Annual operating expenses, steam 22,600.00

Difference in favor of Diesel \$13,400.00 per annum or 2½ times the total interest and depreciation on Diesel plant.

Or, the cost of current with steam engine for operation alone exceeds the total cost of current with the Diesel.

Steam Plant Equipment.

2-200 h.p. Cross compound condensing Corliss Engines for direct connection to alternator; 100 r.p.m.; for 150 lb. ga. pressure and 24 vacuum ref'd to 30 Barometer.

2-140 k.v.a. 80 per cent P.F., 60-cycle, 3-phase, 2300-volt, 100 r.p.m., Eng. type generator.

2 belted exciters for same.

2 jet condensing equipments, complete for above engines suitable for 24 in. vacuum ref'd to 30 Barometer, with water at 70° F.

3-100 h.p. (1000 sq. ft. heating surface) boilers, complete with all trimmings.

1 oil burning equipment complete for above boilers.

2-200 sq. ft. closed heater.

2-50 g.p.m. feed pumps.

All station piping.

2-12000 gal. oil storage tanks.

This comparison is a most rigid one, showing a lighting and power load, the Diesel plant consisting of two engines direct connected to generators, price per barrel for oil being placed at a high figure—in the case of the Diesel \$1.50 per barrel, the cost of the steam

plant \$1.20 per barrel. It is interesting to note the difference in favor of the Diesel and its comparison with the total interest and depreciation on the Diesel plant.

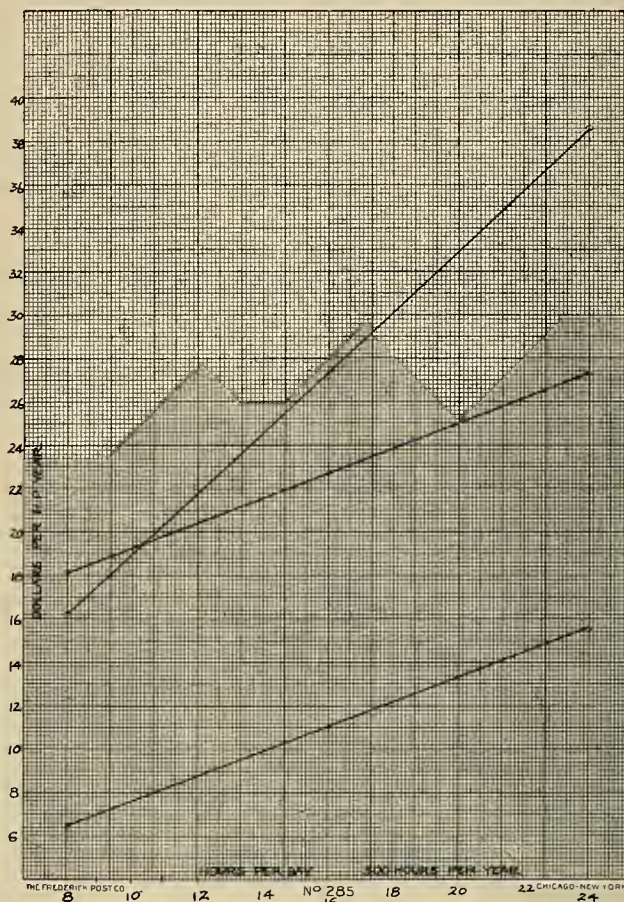


Fig. 27.

Another interesting comparison between the cost of power as produced by the Diesel engine compared with the cost of purchased electricity is illustrated in the following example: Assume a plant to consist of two 500 h.p. engines, generators, exciters and all necessary equipment, delivered and erected for \$78,000, interest figured at 7 per cent per annum, a sinking fund of 7 per cent fixed charges, including taxes and insurance, to amount of 15 per cent per annum on the total investment. The operating cost is shown on the basis of 8 hours, 16 hours and 24 hours' operation, with oil as noted at \$1 per barrel. The cost of power, including fuel oil, lubricating oil, maintenance, labor and fixed charges show a total cost per horsepower year varying from \$18 to \$27 as against the cost of purchased electricity at 1 cent per kw.-hr. of \$16 to \$38 per h.p. per year. The result of this comparison is plotted in Fig. 27 and shows that as the number of hours of operation increases the cost of purchased electricity increases at a more rapid rate than electricity produced by the Diesel engine and that if the plant is operated for over 10½ hr. the Diesel is the most economical type of prime mover. This emphasizes plainly the bearing of load factor to the cost of power compared with the purchase of electricity. If the proposed plant operates more than 10½ hr. it would be more economical to install the Diesel engine than to purchase electricity at the low rate of 1c per kw.-hr.

REPORT ON COLUMBIA RIVER POWER PROJECT.

BY L. F. HARZA.

Appendix G—Problem of Flood Control.

[Continued.]

The Camere gates. There are required for this scheme 11 openings each with bottom elevation of 70.0 and with a clear width of 80 ft. between piers together with a capacity in the form of roller dams equivalent to one additional opening. The 1894 flood rose to elevation 148.6 at which elevation the cross section thus provided is 6290 sq. ft. per opening or total area of 75,500 sq. ft., requiring a velocity of 18.7 ft. per second at entrance to the gateway and with a drop in level of 7 ft. (the available fall), a velocity of 20.4 ft. per second at discharge.

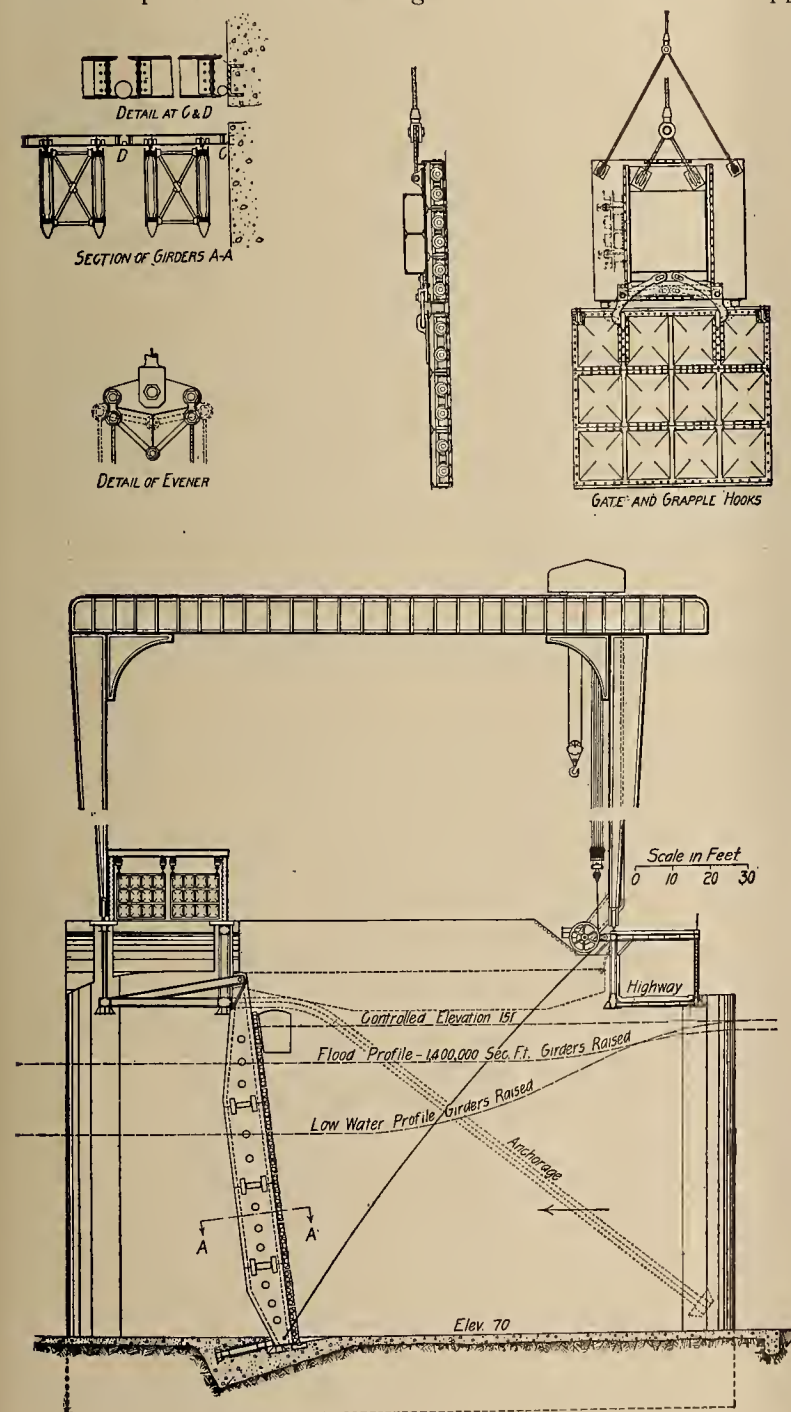


Fig. 37. Camere or Vertical Girder Type of Removable Dam.

A general drawing of this type of flood gate is shown in Fig. 37. The piers would be 20 ft. thick, 100 ft. apart between centers, and about 170 ft. long between pointed ends. They would be joined by a concrete arch used as a working platform at the downstream end of the piers, as also by two vertical steel trusses, one to carry the load of a traveling gantry crane and the other the pin connected or hinged ends of vertical steel girders, spaced about 7 ft. 8 in. apart and spanning from a seat in the bottom of the channel to a truss in a horizontal plane whose chords are built in with the lower chords of the two vertical trusses above mentioned and which is anchored into the upstream ends of the piers. At the upstream end of the pier would be a through highway bridge with an upper deck used for an operating platform and with one truss carrying the gantry crane. The girders (or wickets) would be free to turn about their upper pin bearings and would be built together in pairs with a heavy lateral system. Each pair of girders would be lifted out of the water by a gantry crane pulling vertically by means of two chains around sheaves on the lower end of the gantry leg and sustained horizontally while pulling by a pin connection to the upper lateral system of the bridge.

An auxiliary hook of the same gantry would raise and lower gates which roll on rails down the upstream side of the girders, thus completing the closure. The vertical girders, would be 10 ft. deep and about 92 ft. long, made (as shown in Fig. 37, Section A-A) of two outside web plates 18 in. apart, with interior flange and stiffeners. Access to the interior flanges and stiffeners. Access to the through frequent manholes in the center of the webs. They would be built and hinged in pairs with a lateral system designed to withstand a velocity of 33 ft. per second, assumed to approach the girders, when down and acting as a simple truss between upper and lower supports, at an angle of 20 degrees with the direction of the piers; but assumed to approach at an angle of only 10 degrees during the process of raising when this lateral load would need to be taken as a cantilever supported only at the upper pin connections. The difference in assumed angles of approach is based upon the assumption that, when down with part of the gates in place, an adjacent girder with gates removed would be subjected to a lateral load due to convergence of the lines of flow toward it. The girders would not be lifted until all gates were removed after which lines of flow would be nearly if not quite parallel to the planes of the girders.

The girders would seat on the bottom in cast steel depressed pedestals with large radius cylindrical bearing surfaces and attached to a steel grillage or a steel truss imbedded in concrete. At their upper end they would hinge in an eccentric pin which could be rotated sufficiently by a worm gear to lower the

girders onto a seat at the bottom, thus relieving the truss of their continuous weight although designed sufficiently strong to stand it. This rotation would also, if desirable, seat the girder at the top against a cylindrical cast steel seat on the chord of the horizontal truss, thus relieving the pin. Wedges as in a draw bridge could also be used to accomplish this latter purpose.

The gates would be of steel I-beams with buckled skin plate. The wheels would be of cast steel with finished hubs and rims and bronze sleeved shafts running in cast steel journals bushed with another composition of bronze, or roller bearings might be used as an alternative.

A scheme has been devised by which grease could be forced through the bearings by a small grease compressor actuated by the rotation of the wheel itself and so designed that it would cause the grease to flow and escape into the water regardless of the direction of rotation, thus not only lubricating the bearing but also preventing dirty water from entering. The wheels would be placed along the back of the gates, to run on crane rails along the upstream flange of the two companion girders. It will be noted in Section A-A, that the gates span the companion girders and one-half of the intervening opening, so that the wheels are protected in their position behind the gates. Each gate would clear the adjacent one by about 4 in., which opening would be sealed afterward by forcing down a 6 in. flush-joint pipe bearing upon the out-turned flanges of the side channels of the gates (except next to the pier where a smaller pipe would be used). A machine, not shown in the sketch, has been devised for forcing down and raising these pipes.

The gates would be raised and lowered by the auxiliary hoist of the gantry crane, using a grappling device shown in Fig. 37. This device consists of a steel structure similar to the gates (except narrower and filled with concrete for weight) and travelling on the girder rails on wheels of the same description. On the water side of this structure would be a sliding element filled with concrete or otherwise weighted and limited in its movement to a few inches. Extended arms of two grapple hooks would attach loosely to the lower edge of this sliding weight by means of slotted holes. With the weight at the upper limit of its movement the hooks would engage eyes at the upper edge of the gate and would disengage again upon lowering. The grappling apparatus would be lowered by means of the outer crotched line attached to the main structure, after which the tension would be reversed to the other cable and the gate would be engaged and raised. The gates would be stored by hanging from individual trolleys travelling on the lower flanges of I-beam supports along the concrete arch.

While the dam is closed the cables or chains which lift the girders would lie along the lateral bracing of the companion girders and behind the rolling gates. When it is desired to open a gateway the gates would all be raised by the auxiliary hoist and stored. The main hook from which is hung an equalizer (see Fig. 37) for pulling evenly the two chains, would then travel from the upstream end of the crane to the operating platform at the other end, carrying

with it an auxiliary line from a motor-operated drum to the right of the main sheave, (not shown). The evener would then pick up the ends of the two pulling chains or cables and return to the upstream end, with the aid of the auxiliary line to prevent swinging to the left with the current, where with its further aid the chains would be brought around the sheaves ready to pull. There are two sheaves overhung from their bearings with their grooves spaced the same as the evener supports, which would make it very difficult by hand work to spread the chains sufficiently to get them around the sheaves. For this purpose the evener shown in Fig. 37 has been provided, in which the chains are spread by a toggle joint operated by a second line pulled by a small drum on the main trolley above.

The girders would then be raised from the water to a horizontal position shown dotted, where they would be hung at their lower ends by means of an eye bar, to the adjacent truss. The pulling chains would then be laid out for storage along the lateral system of the horizontally suspended girders by travelling the trolley to the left.

There are of course many details of construction and of the maneuvering program not described here. The loads to be lifted are large. The pull required to lift one pair of girders against the flowing water would be about 175 tons, the girders themselves weighing about 80 tons each. The auxiliary hoist would be of about 50 ton capacity for maneuvering the gates. The maneuvering program is somewhat elaborate and both the number and weight of parts to be handled are large. Mechanical means have however been worked out for each operation, only part of which are described herein.

Precedent. There is some precedent for the construction of a dam of this type. Several small ones have been built, as for example, for an emergency dam above the locks at Salt Ste Marie and some in Europe. The most important application, however, has been for the emergency dams in front of the locks on the Panama Canal. In this case the girders are hung from a draw span which must be swung across the channel in case of a wreck of the lock gates. The depth of water is 50 ft., length of girder 59 ft., width of opening 110 ft., velocity of water 24.1 ft. per second. Our conditions are as follows: Depth of water 80 ft., length of girders 92 ft., and velocity of water 33 ft. per second. Although our conditions are much more severe than on the Panama, yet it is believed they do not introduce problems of a fundamentally different nature. They would necessitate heavier girders, also the lifting of heavier loads for their removal and the use of a heavier lateral system to provide against possible lateral load when the girders are being lifted and act as cantilevers supported from the truss above.

Structures and lifting loads such as required, although never before used in a similar manner for hydraulic structures, are not unprecedented elsewhere. Stresses from hydraulic pressure can probably be computed with at least as high a degree of accuracy as those from railway loads and the lack of similar precedent for hydraulic structures need not be feared for this reason. The several supporting trusses do not involve serious problems.

The necessary rapidity of maneuvering the removable dam of whatever type, is indicated by the rates of rise of the river, of which the following are the largest on record:

February	4- 5, 1881.....	96,000	second	ft.	per	day
January	11-12, 1881.....	80,000	"	"	"	"
March	3- 4, 1910.....	77,000	"	"	"	"
May	27-28, 1894.....	74,000	"	"	"	"
June	3- 4, 1903.....	74,000	"	"	"	"
March	17-18, 1908.....	69,000	"	"	"	"
March	16-17, 1908.....	66,000	"	"	"	"
June	3- 4, 1909.....	65,000	"	"	"	"
March	16-17, 1906.....	60,000	"	"	"	"

The capacity of one pier opening ranges from 175,000 second feet at low flow to 120,000 second feet at extreme flood and careful estimates indicate that one day would be much more than sufficient for the opening of one section of the dam.

Roller dams. It is not proposed that close control of the head be had by means of these Camere gateways. For close regulation there are provided 7 steel roller dams of the type patented and built by the "Maschinenfabrik Augsburg Nurnberg A. G." at Gustavsborg, Germany. They would close openings having a clear width of 50 ft. between piers and depth of 30 ft., which is only slightly larger than structures already built and operated by this company. These gates would be in lieu of one opening of Camere dam and would have a capacity when all open of the same as the capacity of one Camere opening at greatest discharge. It is proposed that they be maneuvered to maintain a constant headwater until, in opening, the capacity of one Camere gateway is reached and the river rising, at which juncture they will be closed while one unit of the latter is opened. Each unit of the Camere type would thus be either entirely open or entirely closed. Two of these roller dams would be on the Oregon side and would be used as sluiceways for ice and drift which would be diverted into them by a boom. The remainder would be on the Washington side nearly parallel to the channel, as shown in Fig. 7, (p. 394, Nov. 20, 1915, issue).

Booms and Ice Menace. The roller dams would jointly have a capacity of about 175,000 second feet which, together with the minimum use of water by the power station, would provide for 225,000 second feet. A discharge greater than this has been recorded but three times during the season when ice is possible, namely:

February	6, 1881.....	361,000	second	feet
February	18, 1898.....	260,000	"	"
January	16, 1900.....	251,000	"	"

The presence of ice was recorded in Appendix "B" only on the last occasion. The roller dams would therefore make it unnecessary, except on very rare occasions, to operate the Camere dam during ice season, for which the latter is not well adapted.

It should be said the safe operation of this type of dam when large driftwood or ice is running, is dependent almost entirely upon the successful diversion of same by a boom.

To accomplish this a boom has been provided as shown in Fig. 7, diverting to the roller dam on the Oregon side. The more natural point of discharge would be adjacent to the canal, where the approaching water might aid, but this point is far from the natural river channel and the flood channel into which discharge would take place is here far above tailwater

level, for which reason it is feared that the debris would not be carried away. Moreover, if adjacent to the canal the space occupied by same would be deducted from the available flood channel and a section of removable dam could not be built on the Oregon side to compensate without the provision of an extra operating crane. A boom has also been provided across the power canal immediately below the piers of the removable dam and another one at the forebay of the generating station.

The boom would be built up of solid timber 10 ft. deep and 30 ft. wide laid in courses breaking joints with the underlying course and driftbolted to it. Alternate courses would be channelled with grooves in a diagonal direction into which long bolts sufficient to take the entire shear, would be laid and provided with bearing plates at the end so that the completed structure would form a very heavy timber truss with steel tension members. The boom is designed for the dynamic pressure of a velocity of 10 ft. per second, which is much greater than the average velocity during an extreme flood, and would, it is believed, give the boom sufficient strength to withstand the pressure probable from drift ice, which comes only at a low discharge and consequently sluggish velocity. The boom would rest against two abutments and three river piers built as rock-filled open timber cribs up to elevation 145 with reinforced concrete rock filled cribs above. It would be divided at each pier so that it could be removed, or rebuilt in sections. This boom, if desired, could readily be used as a highway bridge. It could also be provided with rails on which would operate some special travelling rake for assisting the movement of drift toward the sluiceway.

It is not believed that the handling of ice will involve serious difficulties. Contrary to the conditions on eastern rivers, drift ice never runs except at a low flow of the river (see Appendix "E"), the highest recorded stage being that of January 16, 1900, at which time an average velocity of only about one foot per second would have existed just above the dam, with present stream bed, or about 1.30 ft. per second assuming the channel to be filled with sediment up to the sill of the removable dam. The usual stage during a run of ice is much less, and as the river would have a very low velocity for about 8 miles above, or to Celilo, and indeed very little fall for 25 miles above, it is believed that, due to the short duration of ice runs, what could not be passed by the sluiceways and would need to accumulate, would thaw out before endangering the structures.

Entire dependence, however, is not placed upon this belief. In case much ice had accumulated and was continuing to accumulate much faster than it could be passed and this condition threatened to continue to the point of danger to boom, piers or other works, several units of the dam could be opened behind the protection of the boom and one or more sections of the latter could then be loosened at the piers and allowed to swing back. The ice would then escape and flow only to the open units of the dam where no danger could result, it being remembered that injury to the dam from ice or drift would occur only during the maneuvering interval.

(To be continued.)



Typical Effects of Silver Thaw Along Lines of Portland Railway, Light & Power Co.

THE SILVER THAW AT PORTLAND.

The combination of sleet, high winds and freezing temperatures experienced at Portland, Ore., on February 2d and 3d, wrought considerable havoc with electric distribution, railway, telephone and telegraph wires, as is graphically shown in the accompanying pictures. Street car and railway traffic was demoralized. Portland was entirely shut off from rail communication east.

Even the taxicabs were forced to suspend service.

Electric lighting service in the large East Side district and in many other quarters was destroyed by broken poles and wires.

Street cars operated only at irregular intervals. The company gave no assurance of regular service on any line.

Thousands of telephone wires in scattered sections of the city went down.

Morrison street bridge open; couldn't be closed; street car traffic over it was impossible. Broadway bridge couldn't be lifted.

Schools were closed until Monday, February 7th.

Damage from broken wires, poles and other property was very heavy.

Many people could not reach their homes and had

to remain on the West side of the river. The department stores allowed many of their employees to remain in the stores over night.

Five hundred dollars a day was spent by the Pacific Telephone & Telegraph Company in housing and feeding those employees who were unable to get to and from their homes during the storm and in buying toothbrushes and combs for those who are kept down town. Half that amount additional was spent daily in taxicab fees, other employees being sent to their homes in automobiles.

The number of calls over the wires of the telephone company has been doubled during the past few days, the storm making it necessary for stranded business men to telephone their wives of their inability to get home. The plea was made that gossip and lengthy conversations be temporarily eliminated in order that the company may be able to handle all the emergency calls that it had been called on to transmit because of the extreme weather conditions.

By the 5th, car service and vehicular traffic were opened upon the principal car lines of the residence sections. This was accomplished with the assistance of about 3000 men, 1000 of them in 17 crews under the direction of Commissioner Baker and Park Superintendent Convill, and 2000 under Fred Cooper, super-



Effects of Silver Thaw on Telegraph and Telephone Lines.

intendent of the Portland Railway, Light & Power Company. The cost of the snow storm to the city alone, paid out for labor, was \$30,000.

All of the engineering force of the Portland Railway, Light & Power Company turned out and gave their assistance as foremen or any other job that would assist in restoring service.

The loss as "estimated" by the various companies affected is as follows:

Western Union Telegraph Company—\$2500 to \$3500. Worst damage north of Portland.

Home Telephone & Telegraph Company—\$25,000. Worst damage in Lents and Mt. Scott Districts. No cable work came down except where same was caused by power "burn outs" on same. One pole lead of 67 poles, with 2 and 3 crossarms, all down except 3 poles.

Northwestern Long Distance Telephone Company—\$5000 to \$10,000; 6 pair lead between Portland and Vancouver, Wash., all down,

Postal Telegraph Company—\$10,000. In 21 miles north of Portland between Portland and Goble, there is 21 miles down, with two or three poles standing.

Pacific Telephone & Telegraph Company—\$10,000.

S. P., and S. & United Railways—\$10,000.

Portland Railway, Light & Power Company—\$140,000. Includes loss of substation at Mt. Tabor.

Northwestern Electric Company—\$5000. Break in cable across Columbia River.

Outside construction in Portland was not damaged much as it was extremely heavy in most cases, having been put up for "joint pole" occupancy.

Consequently it is safe to say that the loss occasioned by the storm in a radius of 50 miles of Portland, to the public utilities is half a million dollars.

On the 12th of the month with every available man working overtime, progress was slowly being made in repairing damage done by the recent storms to wire systems of telephone, telegraph, electric lighting and railway companies in and adjacent to Portland. Because their services were needed locally, it was impossible to recruit the local crews of linemen to any large extent from other cities and the work of repair will take longer than had been expected.

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Some years ago engineers were agitating the question of whether the consulting engineer was an economic superfluity. Like many another question, time has furnished the answer. The original type of consulting engineer is fast becoming an economic superfluity but the new type is just as rapidly becoming an economic necessity. The 1916 model of an engineer differs as much from the model of ten years ago as do two automobiles of the same periods.

The consultant's former function was largely that of an individual designer of special apparatus for each new installation. His present duty is largely confined to the selection from a number of available designs of the one best suited to the installation.

This change is due to the standardization in the design of machinery, which has eliminated the need for much of the designing work in new construction. There was a time when most of the apparatus installed in power plants was made in accordance with special specifications. The early California hydroelectric transmission systems, for example, had to be designed on the job and not in the factory. Factory designed equipment had not yet been conceived to meet the requirements of advanced practice.

Today many large manufacturers refuse to bid on special specifications from engineers because experience has shown that standardized apparatus is available for all ordinary needs. Steam boilers are now built in accordance with the standards set by the American Society of Mechanical Engineers. In electrical equipment, the best of the special designs have been adopted as staple practice. Furthermore, manufacturing service now anticipates the consumer's needs. It leads rather than lags. The field of the designer's activity is becoming more and more limited to the factory as the manufacturer realizes that profit comes only from making a staple of the specialty.

This trend is in accord with the natural order of growth which governs all things. The first stage in evolution is aggregation, the next is standardization and the last is segregation or specialization. Then the process is repeated. Power machinery has about reached the second stage in the present cycle.

So, while the threatened encroachment of the catalogue salesman on the functions of consulting engineers has now become an actuality in many lines, the dire results which were feared have failed to materialize. This has been largely due to the improvement in salesmen. The present day salesman is frequently a better engineer in his specialty than is the consultant, the hide-bound restrictions of some engineering clubs to the contrary notwithstanding.

Coincident with the salesman's improvement has been an enlargement in the scope of the consultant. His judgment, instead of being narrowed to the determination of new means to accomplish a desired purpose, has been broadened to a discrimination of what existing means best fits that purpose. The new consultant should be familiar with all makes of apparatus so that he can draw from his own experience and the experience of others in deciding how his object can best be accomplished.

The first engineers were military engineers. Then as the barbarities of war became secondary in the minds of men to the needs of civilization, the civil engineer came into existence. Civilization brought specialization among mechanical, electrical, mining, chemical and a host of other kinds of engineering, taking them far afield into new lines of investigation.

Engineering Preparedness

Now that war, or at least defense against possible war, is again engaging the attention of men, it is found that the lessons learned in civil life, many of which have been necessarily neglected by military engineers, can be applied to the national defense. Though here and there a jealousy of encroaching prerogatives seems to exist, as perhaps evidenced by the resignation of Secretary Garrison, as a whole, military men welcome the co-operation of civilians.

Army men realize that engineers in civil life can be of the utmost assistance in defense if they are properly instructed as regards the requisite organization and possible duties. Lectures are consequently to be given on these subjects by qualified army engineers all over the country.

The present European struggle has demonstrated the need for men who understand the construction of earthwork defenses, trenches and the like, the rapid building methods of communication, the laying of concrete foundations for large guns, the providing of proper sanitation, housing and water supply for camps and supervision of munition manufacture. These are the regular field undertakings of construction engineers and their experience should prove invaluable in military service.

Modern warfare is primarily an engineering problem. The great need seems to be for a reserve corps of engineers should any important contingency arise. This is solely because of the limited number of army engineers available, less than one per cent of the number represented by membership in the several "civil" engineering societies.

Already the national engineering societies are co-operating in a movement to provide an adequate reserve of engineers who would be willing to receive the necessary instruction and to act in emergency. There is no thought of pay for such service, merely a loyal response to the nation's needs. In this way it is possible to repay the debt which many engineers owe the government for their technical education. It has already been made possible for them, under an act of Congress dated January 21, 1903, to take an examination for commission in any volunteer force, other than the organized military called for by Congress in event of war. With such opportunity for service the engineer would be remiss in overlooking it. Engineers have always complained that they are not accorded public recognition commensurate with their ability. Now is the time when these engineering qualifications are at a premium in the public service and here is the chance for the engineer to demonstrate his patriotism and to vindicate his contention.

Why is it that after the economic error of such disturbing elements as the jitney bus, the curbstone electrical contractor and municipal ownership of technical utilities has been conclusively proved again and again that people persist in trying to accomplish the impossible? Why does the mathematical certainty of failure not deter others from rushing in and making fools of themselves? The answer is human nature. It apparently heeds neither the truths of economics nor the laws of mathematics.

For instance, the science of economics has definitely demonstrated that labor will be helped by the introduction of efficiency methods, scientific management and bonus payments. It is human nature for the labor union to oppose such innovations.

Again, mathematical proof of the fact that bodies which had sunk to a depth of two miles would not come to the surface was announced by a Harvard professor after the Titanic disaster, when young Vincent Astor offered one hundred thousand dollars for the recovery of the body of John Jacob Astor. Yet the searching parties found not only the body of Astor, but also of many others who had merely put on life preservers. Thus did human nature confound mathematics.

About the time that one man finds that it is hopeless to run a jitney at a profit there is another ready to take his place. As fast as one curbstone contractor fails he is replaced by another. There is always a new crop of municipal ownership advocates ready to fill the ranks left vacant by the discredited. The supply of the foolish is said to be replenished at the rate of one a minute and to be everready to precipitate themselves into situations where the super-wise hesitate to venture.

This particular phase of human nature is due to ignorance. It is the inertia that limits human progress. It cannot be suddenly reversed but can be gradually guided. While, as already stated, it apparently acts contrary to the principles of economics and mathematics, in the long run it will be seen to conform to them.

Concretely, this means that education is the only corrective for such economic errors as has been here pointed out. Far-sighted men of affairs realize that human nature can be guided by teaching it and so it behooves constructive organizations like the National Electrical Contractors' Association, the American Electric Railway Association and the National Electric Light Association to conduct a campaign of education in order to remove the evils which threaten their path.

To be effective, it would sometimes appear that such educative campaigns should be based upon an appeal to passion rather than to reason. This is the method adopted by the demagogue in appealing to the motive of hatred. Cold facts seem to have little chance in the heat of the passions thus generated. To fight fire with fire it seems desirable to employ the baser motive of self-interest. Teach the individual that in these practices he is hurting himself more than the other fellow and he will desist.

PERSONALS

W. S. Berry of the Western Electric Company, and wife, leave for Honolulu on February 23d to be absent for a month.

C. R. Downs, president of the Amador Light & Power Company of Amador, California, was a recent visitor at San Francisco.

John Hood, engineer with the General Electric Company, at San Francisco, has returned after a brief business trip throughout the Sacramento Valley.

Robert E. Richardson, an official of the Electric Bond & Share Co., of New York, is at Salt Lake City investigating the rates of the Utah Power & Light Co.

F. H. Leggett, Pacific Coast manager of the Western Electric Company, has returned from a trip throughout the northwest. He reports business prospects very bright.

B. J. Klein, Pacific district manager of the Bristol Company, has returned to San Francisco after a successful business trip to Los Angeles and the San Joaquin Valley.

J. L. Randolph, president and general manager of the Turlock Home Telephone & Telegraph Company of Turlock, California, was a business visitor at San Francisco last week.

Frank Fowden, formerly connected with the Brooks Pollis Electrical Corporation of San Francisco, has recently joined the sales force of The Appliance Company at San Francisco.

C. B. Hall, secretary and treasurer of the Illinois Electric Company of Los Angeles, is attending the quarterly meeting of the National Electrical Supply Jobbers' Association at Detroit, Mich.

Miles Steele, salesman with the Benjamin Electric Manufacturing Company at San Francisco, has just returned after an extended business trip throughout Arizona and southern California.

H. B. Kinney, formerly of the Calistoga Light & Power Company of Calistoga, has recently severed his connection with that company and is now connected with The Appliance Company of San Francisco.

Jos. Minnie, electrical engineer with the Pacific Gas & Electric Company, has returned to San Francisco after an extended tour of inspection of the power plants of the company throughout Northern California.

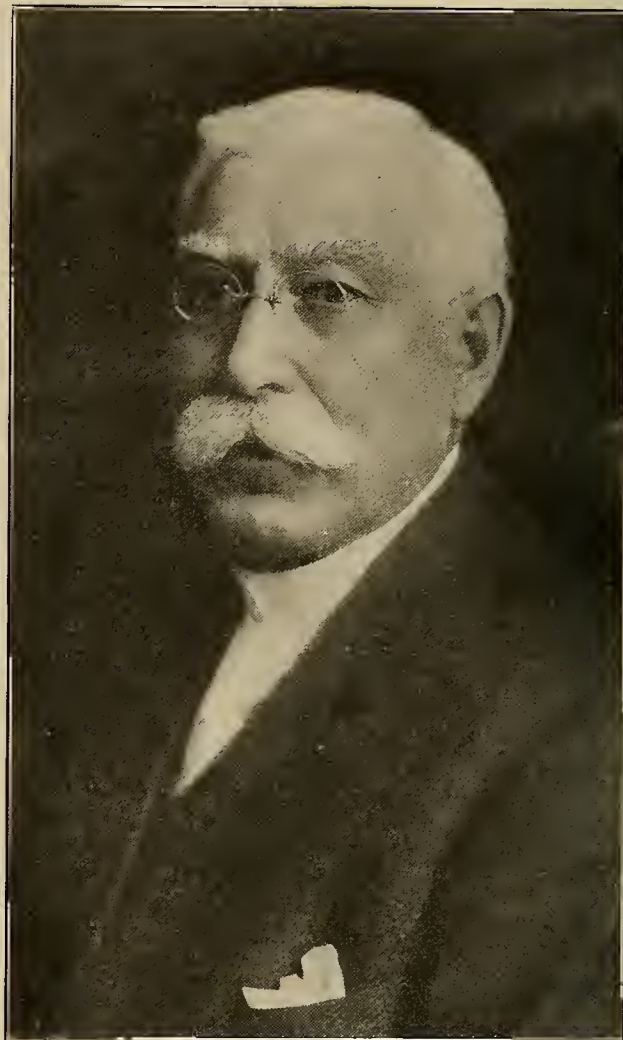
Wynn Meredith, member of the firm of Sanderson & Porter of San Francisco, is expected to return about the middle of next week from his recent trip to New York, where he attended the annual meeting of his company.

Albert Meinema, city sales manager Electric Appliance Company; **J. C. Kelsey**, vice-president and financial editor Telephony, and **R. H. Coyne**, Pacific Coast sales manager Kellogg Switchboard & Supply Company, conversed over the long distance telephone lines from San Francisco, Redlands and Los Angeles, Cal., respectively, with delegates in attendance at the Wisconsin Independent Telephone Association at Madison, Wisconsin, last week.

Chas. R. Betts, Palo Alto, California; **F. E. Draper**, safety inspector and safety engineer, Los Angeles, Cal.; **L. B. Hedge**, chief electrician Ely Light & Power Company, East Ely, Nevada; **E. L. Hughes**, electrician Northern California Power Company Cons., Red Bluff, Cal; **M. L. Jones**, light and power solicitor City Light, Seattle, Wash.; **H. F. Lickey**, instructor of physics and mathematics, Hailey High School, Hailey, Idaho; **R. Gordon McCurdy**, engineer Joint Committee on Inductive Interference, Railroad Commission of California, San Francisco; **S. W. Park**, electrician, Britannia Beach, B. C., Canada; **F. B. Post**, draughtsman electrical engineering department, Puget Sound Traction, Light & Power Company, Seattle, Wash., and **O. E. Smith**, switchboard operator, station M, Portland Railway, Light & Power Company, Estacada, Ore., have been elected associate members of the American Institute of Electrical Engineers.

OBITUARY.

Delos Allen Chappell, president of the Nevada-California Electric Company, died at Denver, Colorado, last week from pneumonia. His death marks the passing of a man truly great in character and in achievement, one to whose foresight, energy and remarkable ability is due in a large measure the development of the latest resources of the West. Born near Williamson, Wayne Co., New York, April 29, 1846, he spent most of his early life on the farm. He was a student of the



Delos A. Chappell.

University of Michigan with the class of 1870 until an accident to his father made it necessary for him to take his father's place in the management of the farm.

In 1873 Mr. Chappell assisted in the construction of the water supply system of the city of East Saginaw, Michigan. The experience thus gained led him to engage in 1874 in the engineering and contracting business at Chicago where he continued in the business of constructing numerous water works until 1879, when he removed to Trinidad, Colorado, where he undertook the construction, as a private investment, of the water works system for the city of Trinidad, which was later purchased by the city. It was at this time that he became identified with the development of coal mines in Colorado, and his ability as an organizer and manager of large developments soon made him a power in the mining industries of the state.

After developing a number of large coal properties which were subsequently leased to the Colorado Coal & Iron Company, he purchased and operated the mines his interest in which he sold to the Victor American Fuel Company in 1906, when he withdrew from active participation in the business and spent a few years abroad with his family.

On his return home, he became interested in the development of electric water power on Bishop Creek, Inyo county, California, the first power plants being constructed for the purpose of serving the then growing mining camps of Goldfield and Tonopah. Subsequently, he became largely interested in the power developments of the Pacific Power and other companies in Mono county, California, all of the developments meantime being gradually merged and consolidated into a unified system serving a large and growing section of western Nevada and central and southern California.

Within the last year, largely through Mr. Chappell's instrumentality, the organization of The Nevada-California Electric Corporation (of which he was president) was consummated, this latter company acting as a holding corporation for numerous underlying companies, including The Nevada-California power Company, The Southern Sierras Power Company, Bishop Light & Power Company, Corona Gas & Electric Light Company and the Interstate Telegraph Company. Recently, the same interests with which Mr. Chappell was identified took over the Holton Power Company, Coachella Valley Ice & Electric Company and the Holton Interurban Railway Company, previously developed and operated by W. F. Holt, of Redlands. The deal by which the latter companies were taken over was finally consummated on January 15th, the day Mr. Chappell met with the accident resulting in his death.

On December 19, 1883, Mr. Chappell was united in marriage to Miss May Chase Hastings, who died at Santa Barbara in 1911. There survive a son, Delos A. Chappell, Jr., now a student at Stanford University; a daughter, Jean Chappell Cranmer and his sister-in-law, Mrs. Margaret Officer, who since Mrs. Chappell's death, has made her home with Mr. Chappell in California.

N. E. L. A. ELECTRIC RANGE COMMITTEE MEETING.

The future of the electric range business was discussed at a meeting of the electric range committee of the Commercial Section of the National Electric Light Association at Salt Lake City on February 7th and 8th. The greatest present factor in popularizing the electric range is the solution of the water heating problem. The committee agreed that the electric water heater can be used only as an auxiliary and that the solar heater is best adapted for most of the Western territory.

Plans are being prepared for a co-operative advertising campaign for electric ranges and other devices, the national advertising being of such a nature that each central station can tie in its local advertising with it.

The committee has a number of suggestions on the size, type and make-up of ranges which will be followed by the manufacturers. The final report of the committee will be presented at the Chicago convention of the National Electric Light Association in May.

The following members of the committee were in attendance: W. R. Putnam, sales manager Utah Power & Light Co.; S. M. Kennedy, general agent Southern California Edison Co.; M. C. Osborn, manager commercial department Washington Water Power Co.; S. V. Walton, manager commercial department Pacific Gas & Electric Co.; E. A. Wilcox, heating device specialist Great Western Power Co., and A. C. McMicken, sales manager Portland Railway, Light & Power Co.

Representatives of range manufacturing companies present included A. K. Baylor of the General Electric Co., Geo. Hughes, president of the Hughes Electric Heating Co.; E. H. Richardson, secretary Hot Point Electric Heating Co., and Mr. Kahn, of the Estate Stove Co.

S. R. Inch, operating manager of the Utah Power & Light Co.; Robt. E. Richardson, of the Electric Bond & Share Co.; H. D. Randall, Salt Lake manager for the General Electric Co.; C. D. Lamoree, sales engineer with Westinghouse Electric & Mfg. Co., and several representatives of the Utah Power & Light Co., were also in attendance.

MEETING NOTICES.

San Francisco Electrical Development and Jovian League.

Notwithstanding the absence of both the president and the vice-president the luncheon February 9th, under the able leadership of R. M. Alvord, chairman of the executive committee, maintained the high standard of excellence and interest which has been set. This was in no small measure due to S. P. Russell, manager of the H. W. Johns-Manville Company's electrical department, who as chairman of the day, had provided fine music and a good speaker in the person of L. R. Hoff, general sales manager for the company. Mr. Hoff took as his subject "Business Building for the Future," showing that the holding of our position in world trade demanded sincerity, integrity and a high ethical plane of business dealing.

Oregon Electrical Contractors' and Dealers' Association.

On February 9th the Oregon Electrical Contractors & Dealers' Association was practically reorganized, a new set of by-laws and code of ethics being adopted. New officers and a board of trustees were also elected. The interests represented are following out a line of action by which they desire to conserve the electrical business for the strictly electrical concerns. This, to offset the fact that in recent years many firms have added electrical features to a business which is in the main devoted to some other line. Under the new organization, "central station" men, jobbers and others not actually retailing or contracting in the electrical line, but who manufacture or deal in power or electrical equipment are given an associate membership in the state organization. The new set of by-laws, of which the code of ethics forms a part, will tend to carry out the desires of the dealers and contractors who devote their entire time to the electrical business, that the business should remain in the hands of those actually engaged therein, and not be "shot to pieces" so to speak, in the hands of those who merely look at it as a "side issue." The new officers elected by the organization include W. O. Fouch, of the Western Electric Works, president; S. C. Jaggard of the Morrison Electric Company, and J. Tomlinson, of the Pierce-Tomlinson Electric Company, vice-presidents, and these last two with F. C. Green of E. L. Knight & Company, and Guy C. Littler of the West Coast Engineering Works, as a board of trustees.

Portland Sections A. I. E. E. and N. E. L. A.

The regular monthly meeting was held February 8th in the auditorium of the Electric Building, Portland, Oregon. Mr. J. E. Davidson acted as chairman. The first speaker of the evening was Edw. Cockingham, vice-president Ladd & Tilton Bank, on the subject of "Finance." He said in part, "All finance is built upon 'credit.' Credit is a promise to pay on demand at a future time. Confidence is the structure on which 'credit' is built. Confidence, to endure, must be built upon a sound foundation. A government \$10 federal reserve note is a good illustration of national credit. The banking power of the United States exceeds that of England, France and Germany combined. This represents \$187,000,000,000. Nine-tenths of the world's business is done on credit. The government's credit is strong because it has the power of 'eminent domain' or taxing power. There are twelve essentials which a manufacturing concern must have before it can hope for success. (1) A useful article to manufacture; (2) It must be organized into a good company; (3) Must have necessary capital; (4) Must have a proper business policy; (5) Must have a competent business manager; (6) Must have a proper location; (7) Must have a well designed plant; (8) Must have a good organization; (9) Must have a loyal organization; (10) Must have perfection in the design of its products; (11) Must have a perfect system of manufacturing; (12) Must have a complete and comprehensive system of accounting.

It has been said many times that the most necessary prerequisites for the success of a business are the three 'C's,'

Capital, Capacity, Character. Reviewing the present financial conditions he quoted from a Scotch author the following: "War brings Poverty, Poverty brings Peace, Peace brings Prosperity, Prosperity brings Pride, Pride brings War." Before the present war England was the credit nation of the world and the United States a debtor nation. A pound sterling was the standard of exchange. There were 5 to 6 billion United States securities held in Europe. In 1870 Germany did 7 per cent of the world's commerce; in 1910 she did 18 per cent; and it must be remembered that the world's commerce increased in volume in a tremendous manner during these years. During this time she developed a military machine and a great industrial machine as well; also a colonial system was developed, also a navy and merchant marine. This rivalry between England and Germany for trade and economic supremacy caused the war and not political differences. During the first year of the war \$1,800,000,000 trade balance in favor of the United States was gained and about \$1,500,000,000 of the United States securities were absorbed. In the future I see 'Opportunity' and 'Peril.' Germany's industrial power is only sleeping. Her markets of the past will be cut off, England, France and Russia—so she will turn to North and South America."

Mr. Cockingham called attention to the fact that this year was the one hundredth anniversary of the first public savings bank in the United States and said he wanted to impress upon all those present the necessity of "thrift."

The second speaker, Mr. Ben C. Dey, assistant counsel Southern Pacific Railway Company, did not speak upon the subject assigned him, "Elementary Principles of Business Law," as he said he could not do justice to the subject in the limited time he could speak. Instead he made a few remarks on the subject of "Contracts." Also stated that he was in favor of a law requiring a "Bill of Necessity" from public utilities before new corporations could go into business in the state of Oregon. The public were absolutely protected, as the public service commission had the power to regulate the "rates" and the "service." As the present regulation, both national and state, is very burdensome and inefficient, a new bill has been formulated and introduced into congress by Mr. Cook, attorney for the Postal Telegraph Company, to regulate the railroads of the United States. Government ownership of railroads is not desirable under our form of government, as they would become a dominating factor both politically and financially.

The idea of the Cook bill is to take the control of the railroads away from the capitalists and give it to the people. At the present time there are 117 directors, having control of the 160,000 miles of railroads in the Mississippi Valley, which comprises 24 states. Twenty-three directors live in the Mississippi Valley and fifty-eight live in New York City. The Vanderbilts control their properties and only own 8 per cent of the stock. Hill controls the Great Northern with 7 per cent of the stock. One-half of the stocks of the railroads are held by other railroads. The bill provides for five federal railroad companies. Each company to have nine directors, six elected from the district in which the company operates. A federal board to be composed of six members, one from each federal company and one from the Cabinet of the United States, to be appointed by the President. Money to operate under being raised by guaranteed government bonds; interest to be $3\frac{1}{2}$ per cent; stock to be issued in \$10 denominations. It is estimated that the government would make \$24,000,000 a year profit after paying the $3\frac{1}{2}$ per cent. The scheme would eliminate waste and bring us "Industrial Peace," is claimed by the author.

He mentioned the fact also that locomotive engineers were paid on an average of \$215 per month. Motor men on interurban electric trains, \$175 per month, and conductors \$146 per month.

After the meeting doughnuts and cider were served. The next meeting will be under the auspices of the A. I. E. E.

and Prof. Wm. C. Morgan of Reed College will give a talk on "Industrial Chemistry."

Oregon Society of Engineers.

The fifth annual meeting and banquet of the Oregon Society of Engineers was held at the Portland Commercial Club, February 7th.

The report of Secretary Stanley consisted of a short talk on "Co-operation." The report of Treasurer Morse showed that the society had expended \$919.04 during the year and had funds to the extent of \$731.45 on hand.

The first issue of the Journal of the Oregon Society of Engineers was distributed at the banquet and it was explained by the secretary that it was the intention of the association to print all the papers available in the journal—including those presented before the society and any others deemed worthy which are contributed by the members. In addition to this the society will publish a monthly bulletin.

The returns of the election held during the past month were announced:

Philip H. Dater, Vice-Pres.	F. H. Naramore, Director.
Orrin E. Stanley, Secretary.	H. L. Vorse, Director.
Henry M. Morse, Treasurer.	Douglas Taylor, Director.

An amendment to the constitution was passed making provision for student members, dues to be \$1 per annum.

The subject of permanent headquarters was brought up for discussion, and the subject was referred to the executive board with instructions to investigate the subject and see if the other technical societies would entertain a proposition to enter into an agreement to establish a permanent place for an "engineering headquarters." Also to see if same could be had in the Commercial Club Building. It was announced by the president that the Oregon Society of Engineers would be represented by delegates at the conference held in Eugene for the purpose of discussing "Irrigation and Rural Credits."

The second portion of the program consisted of a motion picture show, at which the Finley pictures of animal life were shown. Ladies and friends of the engineers were guests of the society for this portion of the annual meeting. Attendance at banquet, 55.

Los Angeles Jovian League.

The regular weekly luncheon was held February 9th at Christopher's, President Holland occupying the chair. H. N. Sessions, the astute and versatile compiler of programs, announced "A swell feed, a peacherino talk, a fine entertainment, and a chance to mix with the gang." Harry was right. A large number of visitors were present, and after the introductions and discussion of various business matters, at which time J. Harry Pieper announced the appointment of a Jovian Committee to assist in the Occidental College \$1,000,000 campaign, the gavel was turned over to Jas. E. Tucker, vice-president and general manager of the Greenwood Advertising Company, whose popularity as a Jovian was demonstrated by the loud and prolonged applause which greeted him. After a few remarks, he introduced the speaker of the day, Rev. Robert Freeman, pastor of the Pasadena Presbyterian Church of Pasadena, who spoke on "Individuality." His address was interspersed with Scottish dialect stories, and his rare wit and humor kept his audience in a continual uproar. He defined individuality as the discovery of, and the conformity to, the laws of one's own being; and said that it is the duty of each generation to discover and apply new laws hitherto unknown, the duty of each individual to discover laws for the elevation of his own personality, to discover his own capabilities, and to live in harmony with the higher laws. An excellent musical program was also provided.

Considerable interest is being manifested in the coming rejuvenation, to be held February 18th at the Elks' Hall, which is expected to surpass anything that has heretofore been attempted here. R. C. Starr is chairman of the arrangement committee, El. B. Clay will supervise the floor work, and A. L. Spring will captain the degree team.



NEWS NOTES



INCORPORATIONS.

TUCSON, ARIZ.—Articles of incorporation of the Rillito Water Company has been filed by Heber E. Farr, Frank J. Webb and Louis P. Cardon, all of Tucson. The authorized capital stock is \$50,000.

TEMPE, ARIZ.—The Burns Electric Company has filed articles of incorporation with principal place of business in Phoenix. Capital stock, \$1,000,000. Incorporators, Paul H. Schmidt, Herbert Harper and Michael A. Burns, all of Evansville, Ind.

SALEM, ORE.—The West Coast Gas Company, capital stock \$5000, S. R. and Velma Hammer and P. A. Williams, incorporators, has filed articles of incorporation. The company proposes to establish steam, gas, light and hot water plants in Linn county and will have its headquarters at Albany.

LOS ANGELES, CAL.—The Omega Mutual Water Company, which has just incorporated, will furnish water for the 73,000 acre tract of the San Joaquin Valley Farm Lands Company near Fresno. The concern is incorporated for \$500,000. It will operate pumping stations and pipe lines to be installed soon. Fifty artesian wells will be sunk.

FRESNO, CAL.—Certification of the articles of incorporation filed almost a year ago by the Fresno Interurban Railway Company, at Sacramento, was recorded in the court house here recently. According to the copy of record filed here, the company is capitalized at \$250,000, with but three stockholders. George H. Bradner owns 98 shares and John B. Rogers and Paul T. Fratessa own one share each. It is stated that the par value of the shares is \$100 each and that \$10,000 has thus far been paid into the treasury. The Fresno Interurban Railway Company plans to build a standard gauge line to accommodate both passengers and freight between Fresno and Clovis, a distance of about 10 miles.

ILLUMINATION.

BURBANK, CAL.—Sealed bids will be received by the board of trustees up to February 23 for electrical equipment.

SANTA CLARA, CAL.—Electroliers are to be installed the entire length of Franklin street when sufficient funds are at hand.

MARTINEZ, CAL.—The supervisors have granted permission to the Contra Costa Gas Company to lay its mains to Port Costa, Crockett and Valona.

RIVERSIDE, CAL.—The city council has ordered the installation of a street lighting system along the west side of North Orange street, between Russell and Oakley avenue.

NEWPORT BEACH, CAL.—The recently voted bonds of \$24,000 for a natural gas distributing system have been bought by the state, at a premium of \$615. Work will begin at once.

PHOENIX, ARIZ.—The New State Electric Supply & Fixture Company has been awarded the contract for additions to the underground street lighting system on its bid of \$18,300.

WINSLOW, ARIZ.—A franchise for a gas plant has been granted to B. A. Hayden of Los Angeles. Construction of the plant will begin within 60 days, and be in operation within six months.

SAN FRANCISCO, CAL.—The supervisors have approved an appropriation of \$7,500 as the city's share for current furnished to the proposed Ryan scheme of illumination of Market street from the ferry to Seventh street.

PASADENA, CAL.—There was only \$12.88 difference in two bids for electric materials and machinery received by the commission. The bidders were the General Electric Company, \$8199, and the Westinghouse Company, \$8211.88.

PHOENIX, ARIZ.—The city commission has directed the city engineer to make an investigation regarding the installation of a municipal electric and gas plant and report findings at the meeting on March 15th.

EUGENE, ORE.—The petitions for ornamental lights on Seventh avenue between Olive and High streets and Eighth avenue were reported favorably by the fire and water committee at a recent meeting of the city council.

HUNTINGTON BEACH, CAL.—At a meeting of the board of trade it was voted unanimously to accept the offer of the Southern Counties Gas Company to serve natural gas at 90 cents per 1000 cu. ft., with a 90 cent minimum charge.

TRANSMISSION.

KALISPELL, MONT.—The Montana Power Company has definitely decided upon the construction of a big hydro-electric plant on the Missouri river near Wolf Creek, according to a statement of an official of that company. The survey will be started in the spring. The site is 30 miles northwest of Helena. The dam will be 1400 ft. long.

TELEPHONE AND TELEGRAPH.

HERMOSA, BEACH, CAL.—The board of trustees has instructed the city attorney to draw up an ordinance advertising the sale of a telephone franchise.

SUNNYSIDE, WASH.—The Valley Telephone Co. has been incorporated for \$50,000, by L. E. Harrington, E. F. Keyes, C. M. Keyes, M. H. Manuel, R. W. Manuel, A. M. Murfin.

RUPERT, WASH.—A deal has been closed whereby the local telephone system owned by Victor & Brown has been taken over by the Bell Telephone Company. Several improvements are contemplated by the new owners.

SUNNYSIDE, WASH.—Geo. Smith has received the contract for constructing the new Benton City telephone system. There will be about 24 miles of line to build. The new system will be conducted by the directors of the Sunnyside Irrigation District of Benton city.

PASCO, WASH.—The city council has received a report from the committee appointed to interview the Twin City Telephone Company to the effect that the management has promised to commence work inside of two weeks and to complete the system by July 1.

TOMBSTONE, ARIZ.—The telephone line of the Pluachuca Water Company will not be repaired for some time at least through Coronado Forest Reserve. The company will immediately rebuild the line to the foothills of Huachuca and up to the Miller Canyon reservoir, however.

STOCKTON, CAL.—Permanent organization of 19 farmers' telephone companies, connecting with the local exchange of the Pacific Telephone & Telegraph Company was effected at a meeting in Modesto recently in connection with the fight of the rural patrons against the raise in rates established about a month ago by the exchange company. Representatives of the 19 companies attended the meeting and elected officers headed by E. L. Routh as president, D. F. Conant, vice-president; M. P. Long, secretary, and John A. Orr as treasurer.

TRANSPORTATION.

EAST SAN DIEGO, CAL.—Application has been made to the trustees of East San Diego for a franchise to construct and operate a street railway for a period ending September 1, 1952. Sealed bids will be received for the proposed franchise up to March 6th.

MARTINEZ, CAL.—J. B. Dodgers of the Martinez & Concord Interurban Electric Railroad and Irving Peterson have made application for a franchise to build an electric line over the county road from Martinez city limits to a point north of Auto Inn, near Pacheco.

STOCKTON, CAL.—An agreement providing for the joint operation of their lines is announced by the Central California Traction and Tidewater Southern railroads. While each company is to preserve its identity, the agreement is said to be tantamount to a merger. The same ticket and freight offices will be used, and one dispatcher will handle all trains for both roads. Employees, it is understood, will be interchangeable.

WATERWORKS.

BAKER CITY, ORE.—The contract for \$75,000 city water line extension bonds has been awarded to Henry Teal of Portland by the Baker commissioners.

ROUNDUP, MONT.—A contract for water main extension, involving an expenditure of more than \$15,000, has been awarded to the Security Bridge Company.

SACRAMENTO, CAL.—The bid of Ambrose & Teichert for an addition to the city water works, at Front and I streets, has been accepted by the commission.

RUPERT, IDAHO.—An ordinance has been passed calling for an election February 29th to vote on \$6000 worth of bonds for the construction of a municipal water system.

GREAT FALLS, MONT.—Taxpayers of Great Falls at the recent election authorized the issuance and sale of bonds in the sum of \$150,000 for the construction of a filtration and water softening plant.

BOISE, IDAHO.—The commission has issued a certificate of convenience and necessity to the village of Roberts for the construction of a municipal water system. The village has bonded itself for \$10,000.

SANTA ANA, CAL.—Four bids were received by the city trustees for a large quantity of water pipe for the water department. The bid of the U. C. Cast Iron Pipe & Foundry Company, of San Francisco, was accepted.

SEATTLE, WASH.—The construction of a sandpipe in the Bacon Hill District with a capacity of 300 gallons, together with the installation of a trunk main in the Rainier valley is contemplated by the water department.

HEMET, CAL.—Damage to the Lake Hemet Water Company as the result of floods will be more than \$75,000. A great deal of flume line in the mountains has been washed away, and the remainder is damaged. Not only irrigation but the domestic water supply is cut off.

SANTA MONICA, CAL.—Petitions for a special election to again submit to voters the question of buying four local water plants for a municipal system will be circulated at once. The value of the plants is approximately \$600,000. The allowance will be added for the connection of the four systems, making a total of \$712,000 for the proposed bond issue.

PORTLAND, ORE.—Commissioner Daly has been directed by the council to proceed with the extension of the Bull Run distributing mains throughout the St. Johns District, duplicating the private system of the St. Johns Water Power & Lighting Company, and City Attorney LaRoche has been directed to prepare an ordinance authorizing the issuance of \$125,000 of water bonds to provide funds for the project.

PORTLAND, ORE.—The contract for carrying out the proposed Suttle's Lake irrigation project at Grandview, Ore., estimated to cost \$600,000, has been awarded to Henry J. Kaiser Company of Vancouver, B. C., and Everett, Wash., at

cost plus 13½ per cent, the lowest bid. James Kennedy of Portland bid cost plus 15 per cent, and Hans Pederson of Seattle, bid cost plus 18 per cent. O. Laurgaard, Railway Exchange Building, prepared the plans.

SAN RAFAEL, CAL.—The state supreme court has issued an alternate writ of mandate directed to William Dodge, auditor of the Marin municipal water district, ordering him to countersign the \$3,000,000 bonds of the district or else to appear in court on March 6 and show cause. Dodge refused to sign, on the grounds that the district under its present organization has not the constitutional right to issue and sell the bonds or to collect taxes for the payment of interest thereon.

FLAGSTAFF, ARIZ.—J. J. Reynolds of Chicago, chief engineer for the Joliet & Eastern Railroad Company, has been in consultation with C. H. Spencer relative to the work to be done on a big water development scheme of the Conconine Water Development & Stock Company, which proposes to develop sufficient water to furnish the Santa Fe, Grand Canyon and other places with water for stock purposes and irrigation. The company will start work on the project early next spring.

TRADE NOTES.

The Holtzer-Cabot Electric Company expects to occupy its new building at 125 Armory street, Boston, Mass., on and after February 22.

NEW CATALOGUES.

Condit Electrical Mfg. Co. of Boston, Mass., have issued a number of new bulletins on oil switches. Nos. 401, A, B and C tell of the protection of small induction motors (started without compensators) by the use of non-automatic, non-automatic with fuse terminals and automatic switches respectively. No. 410 illustrates and describes oil switches for pole line use and No. 411 for manhole installation.

The General Electric Company has just issued Bulletin No. 48017 which refers to the application of electricity in the harvesting of natural ice. The bulletin is illustrated with views of various installations of motors for driving basin saws, field cutter, channel pusher, house ice cutter, and also shows the use of a motor-driven hoist in ice storage. There are also illustrations of various motors applicable to this work.

NEWS OF IDAHO PUBLIC SERVICE COMMISSION.

The Commission has granted a certificate of public convenience and necessity to the Paul Electric Co., Ltd., for the construction of an electric light and power system at Paul, Minidoka County, Idaho.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Commission has authorized the Western States Gas and Electric Company to withdraw \$12,773.86 from the Girard Trust Company, being the amount spent for betterments from a trust fund of \$182,000.

The San Joaquin Light and Power Corporation has filed with the Commission an application for authority to execute a supplemental mortgage to The Equitable Trust Company of New York, to place under its first and refunding mortgage the following subsidiaries to the San Joaquin corporation: The Selma Water Works, The Madera Water Works, The Madera Light and Power Company, The Lemoore Light and Power Corporation and The Bakersfield Gas and Electric Light Company.

The Commission has authorized the Northern California Power Company, Consolidated, to enter into an agreement with the holders of its \$670,000 Series A debentures, dated Feb. 1, 1912, or more than three-fourths of the holders, providing a postponement of the maturing of these debentures from February 1, 1916, to February 1, 1920. The bonds are to bear interest at 6%, and the power company shall pay monthly \$5000 on account of principal.

SAN FRANCISCO
PUB

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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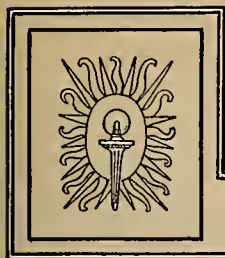
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PACIFIC COAST ELECTROCHEMICAL POSSIBILITIES COMPARED WITH NORWAY AND SWEDEN

BY J. W. BECKMAN.

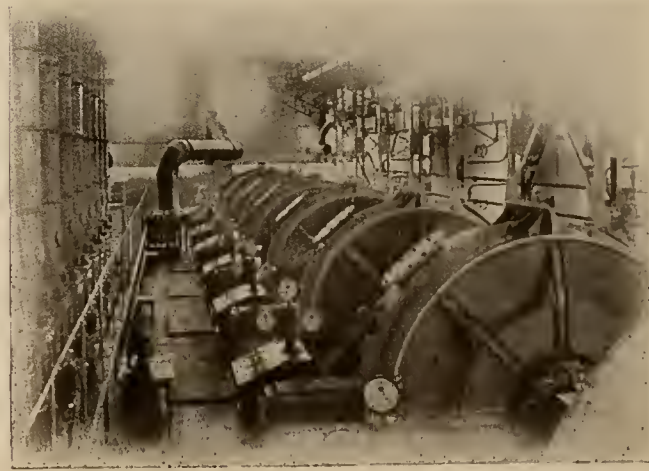
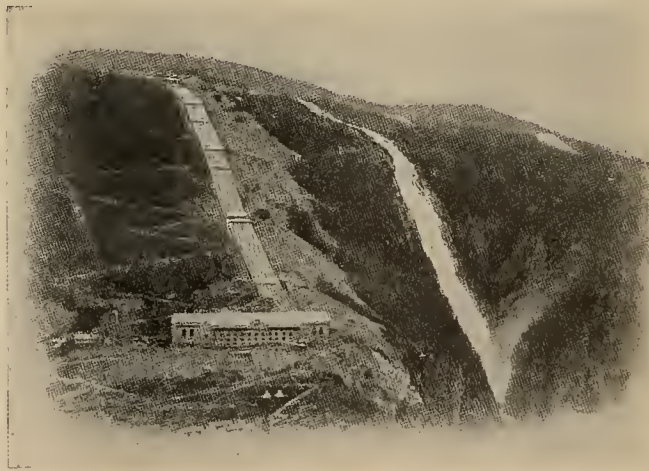
(Here are facts which prove that California, Oregon and Washington have all the requisites for an electrochemical development which should surpass that in the Scandinavian peninsula. The article is slightly condensed from a paper read before the San Francisco Section of the American Chemical Society, Jan. 22, 1916. The author is chemical engineer with the Great Western Power Co. at San Francisco.—The Editor.)

Sweden and Norway, notwithstanding their older civilization and different position on the globe, are in many respects similar to Washington, Oregon and California. Those widely separated portions of the world are alike in size, in population and in amounts of standing timber. Most of the water power sites in each section are located in inland mountains, some distance from the comparatively flat sea coast, though

in Norway, as in British Columbia and Alaska, there are many possible developments on tide water.

The electrochemical possibilities of Sweden and Norway are great for two reasons—an abundance of cheap power and comparatively cheap labor.

In Norway, 7,500,000 h.p. are available at present, of which 500,000 h.p. is developed, and an additional million horsepower is under development. When all



The Rjukan Falls Development in Norway, Employing the Birkeland-Eyde Process of Air Nitrate Production and showing (1) The Forebay, (2) Pressure Pipe Power House and Falls, (3) 18,500 k.v.a. Generators, and (4) Ovens in which the Arc Oxidizes the Nitrogen.

this power is developed it will amount to about 20 per cent of all available power. The largest present, single operating installation is at Rjukan, where 131,000 h.p. has been developed and 119,000 h.p. is being developed. There are two possible 240,000 h.p. developments, neither of which is projected. Many of the installations are inaccessibly located in the interior, involving special means of transportation to reach them, often through sections where power transmission is impossible, partly due to the nature of the country, and partly to climatic conditions.

In Sweden, conditions are materially different. The heads are comparatively low and the nature of the country makes long transmission lines possible. The available power in Sweden is 6,200,000 h.p., of which at present 900,000 h.p. are developed, about 15 per cent of the total available. The largest single development is that of the Swedish government at Trollhattan, in the southern part of the country, where a total of 80,000 h.p. is obtainable. Most of the Swedish developments are low head plants with small capacity.

In the three Pacific Coast states about 11,000,000 h.p. of which 7 per cent, or 831,000 h.p. have been developed. Most of the developments are high heads, 500 ft. or more. Among the most noted proposed low-head developments is at The Dalles on the Columbia River, where about 800,000 h.p. could be delivered. More than half this amount could be supplied twelve months of the year. The remaining power could be counted on for eight to eleven months of the year. In California the Great Western Power Company, in spite of having developed some 100,000 h.p., is still able to develop some 500,000 h.p. more.

On account of local and climatic conditions in the coastal states, long distance transmission is easy and comparatively cheap. As the population is centered in the large valleys and along the coastal districts, the necessary length of power lines from generating stations, located in the mountains, to the consuming districts, are comparatively short, and the lines with few exceptions do not exceed 200 miles.

Power and Labor Costs.

The cost of hydroelectric power is really a question of bookkeeping, and since each plant has its pet way of calculating costs, it is impossible to compare average power costs, not knowing how much, or how little, they include, what the interest rates are, etc. When a standard accounting method is adopted by all power plants throughout the world, then cost comparisons, per horsepower, may have some meaning.

When an industry develops its own power source, the bookkeeping method can absolutely hide the actual cost of the power. On this account I am extremely skeptical as to the low figures of \$3 or even less quoted for the power utilized by some industries in Norway. The prices for power obtainable on the Pacific Coast close to, or at the power site, do not vary materially from those in Sweden and Norway.

The prices for which power may be purchased in those countries vary from about \$6 per h.p. year, and up, provided large blocks of power are taken. In Norway with higher head developments the minimum price may be somewhat lower.

Compare these prices with that of less than \$10

per h.p., quoted by the state of Oregon for power from the projected development at The Dalles, and I believe you will agree that cheap power is available here, as well as in Sweden and Norway.

Only recently has one of the large power companies on the coast entered into contract with an electrochemical company for large blocks of power on tide water at a rate similar to that which is obtainable today at Niagara Falls. Niagara Falls is 500 miles from tide water, which means a long rail haul to seaboard. Power on San Francisco Bay at the same rate means large savings in the way of transportation charges, etc.

The idea that there is an abundance of cheap labor in Sweden and Norway is to an extent a fallacy. Emigration is continuously draining the working stock of the people. The average daily wage is about \$1 to \$1.25. In the more specialized industries, as the electrochemical, the price of labor is somewhat higher.

Compared with the cost of labor on the Pacific Coast, the Scandinavian prices are low. But the ultimate cost of producing electrochemical products, I believe, is no higher there than here, due to higher cost of raw materials there than here.

Electrochemical Industries.

What then are the industries that have brought Sweden and Norway to the front in the eyes of the world as countries that take a foremost position in the electrochemical industries?

When artificial nitrogen fertilizers are mentioned, Norway looms up with its 200,000 h.p., exclusively devoted to that industry. Calcium nitrate and calcium cyanamide are both products made in Norway; the latter is also made in Sweden. The raw materials for these products are cheap power, the nitrogen of the atmosphere, and limestone. In case of the cyanamide, coal is also needed. In Sweden and Norway, plentiful, cheap power is available, not always in accessible places, as the large developments at Rjukan, in Norway show, located as they are in the most impenetrable part of a mountain fastness. Nitrogen is abundant; limestone is accessible in some cases, though in others involving considerable haul by rail or water. The coal is all brought in from England, which means expense of handling and in addition duty on the importations.

The Pacific Coast states are in this respect as favored, in many instances, as the countries of the Scandinavian Peninsula. Take as an example the projected development at The Dalles: deep water navigation is possible up to and beyond the proposed power site; limestone from Washington could be brought in cheaply, quarried as it is right on tide water; coal from China, and eventually from Alaska, could also be brought in and water transportation would be available for the finished product. Similar conditions can be found at other localities on the Pacific Coast.

What has been said in regard to the fertilizer industries, applies equally well to the carbide industries. Sweden consumes some 20,000 h.p. annually in carbide manufacture, and Norway consumes considerably more at the large works at Odda.

The Swedish iron is famous and well known over the world. Until quite recently Swedish iron was losing its reputation. Scarcity of charcoal followed the increasing numbers of shaft furnaces put in operation, until gradually some of the iron masters of Sweden began to substitute coke for charcoal and the common coke pig iron was obtained, with a result that the long established position held by Swedish iron in the markets of the world, was fast slipping away. Today though, it is possible to treble the number of shaft furnaces in Sweden without being obliged to use coke due to the introduction of the electric shaft furnace, where two-thirds of the charcoal, which was used exclusively for heating the charge in the furnace, is substituted by electric heat.

As the earliest blast furnaces were built in Sweden, so also Sweden first successfully solved the electric shaft furnace.

The iron industry of Sweden is located in a narrow strip seventy miles wide and 140 miles long. The approximate distance from Oakland to Sacramento. This small section of the country has brought fame to Sweden through its iron.

As time goes along and the old blast furnaces have to be replaced with new, never again will an old type furnace be placed in operation. Electrical shaft furnaces will be installed instead. There are now over a dozen of these furnaces in operation in Sweden turning out close to 50,000 tons of iron per year.

The raw materials needed in electric shaft furnace operations are cheap power, high grade iron ore, good limestone and an abundant supply of charcoal.

One million tons of charcoal are burnt in Sweden annually. Practically all of it is used in the iron industries. The charcoal is burnt all over the country, and shipped into the iron producing district by rail. The greater part of the charcoal is produced in the old fashioned way of heap-burning, though there is a strong tendency at present to substitute the heap-burning by the large unit by-product charcoal ovens, of which there are over twenty plants installed and operated.

Norway is also heavily timbered, but due to great transportation difficulties charcoal is not produced in such quantities there, nor do I believe they have any electric shaft furnaces at present in operation.

Iron ore is abundant in Sweden. Some has to be concentrated, since high content of silica means an excessive power consumption in the electric shaft furnace. The northern ores from the large famous deposits near the Arctic circle average close to seventy per cent iron, and so do the concentrates from the more centrally located deposits.

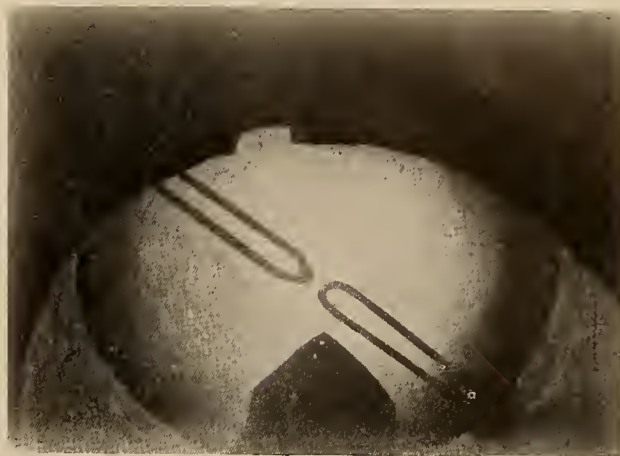
Lime-stone is available though not always in closest proximity to the shaft furnace plant.

Power is often obtained from small hydroelectric developments, where enough energy is required to operate a single furnace, or purchased from a generating station.

What then are the conditions on the Western coast of U. S. A., that would suggest the possibility of an iron industry growing up, similar to that of Sweden.

The three coastal states have practically as much timber land as Sweden; the actual board measure

would be much to the advantage of these states since, due to climate and other conditions, the growth in Sweden is quite light. Incidentally it is of interest to realize that Washington, Oregon and California today contain about one-half of all the timber lands in the United States. There are twenty-eight hundred billion feet of timber in the U. S. A., while these



Electric Arc in Birkeland-Eyde Oven, the Principal Basis of this Patent.

three states have of this amount, thirteen hundred billion feet, assuring abundant supply of raw materials for charcoal burning.

By-product charcoal plants, close to the large lumber operations, should at present not only be the wise policy for lumber operators to follow, but should also give a good revenue from the refuse which at present is a decided nuisance and often a menace, and could thus supply the needed charcoal for iron reduction.

It would take many years to develop one million tons of charcoal per year on the coast, but it is interesting to note that under conditions considerably adverse to our own, this is accomplished in Sweden.

Limestone is abundant all through these states, the quality of which is suitable for smelting purposes.

Iron ores of varying qualities, some of the highest purity, and others less pure, are available at many points in California, and adjoining states.

Power close to power sites, and in the timbered districts, where charcoal could be cheaply made, is obtainable at prices which will make electric shaft furnace operations not only successful, but financially profitable.

Norway and Sweden produce small amounts of ferro-alloys. The raw materials have to be imported. As an example, chrome ore is brought in from New Zealand.

The raw materials for such industries are right at hand in these states, and can be had, in many cases, practically at no cost compared with prices paid for similar raw materials brought in to Sweden and Norway.

Norway produces some aluminum from ore, part of which is imported, and part obtained from local deposits.

The Pacific Coast states have a very large supply of practically pure aluminum oxide awaiting treatment. The aluminum oxide is now in dumps, being a by-product in the potash production from alunite in Utah.

Sweden produces considerable quantities of sodium and potassium chlorate. The raw materials have to stand heavy freight charges, as they are imported from Germany. This is also the case in reference to salt used in the manufacture of caustic soda and bleach.

We are favored here by salt which is readily available, both from the water obtained through solar evaporation and from natural deposits. It may be of some interest to know that a caustic soda and bleach plant is to be built in the near future on San Francisco Bay.

Potassium chloride is to be had from Searles Lake, we hope at no distant date. Meanwhile we may be able to get this salt from various waste materials available on the Pacific Coast, which are now being absolutely neglected.

An industry of special interest, developed in Sweden, is the electric reduction of zinc. Not less than 18,000 h.p., producing close to 4000 tons of zinc per annum, are consumed in this industry. Ores containing both lead and silver, as well as zinc are used, recovering all the values.

Many of the ores of the West, which are now deemed practically worthless due to zinc content, could be advantageously treated in the electric furnace on the Pacific Coast.

Markets.

An industry can never be a success if there is no market for its products.

Sweden and Norway together, have a population of about eight million people, and since the greater part is a rural population, there is a comparatively small demand for manufactured products. Therefore, foreign markets have been sought for the products of the industries.

There is no part of the globe that is not in some way dependent on products made in Sweden and Norway. This wide market field has been developed through necessity, and necessity has forced co-operation. Commercial agencies have been formed in foreign ports through which everything from Swedish lumber and sewing machines to electrochemical products, have been sold. The different manufacturers have maintained these sales agencies jointly, and consequently the selling cost in foreign countries has been brought down to a minimum for the various products.

The nearby European markets are severely competitive, but they have been entered successfully. This has been possible by the high quality and low price of the product. Sweden and Norway, the latter especially, have learned the art of handling tramp steamers. Due to this fact freight rates for products reaching foreign markets, have been brought to a minimum.

It is equally possible for electrochemical industries, or in fact any industry, on the Pacific Coast to penetrate foreign markets. We can reach from this point over one-half of the world's population, by going west and south. Some of the markets are small, but are bound to grow, and if we miss the present opportunity, somebody else will step in and collect the harvest which legitimately belongs to us.

We should profit from what Sweden and Norway have done.

The large electrochemical developments in Norway are financed by international capitalists, involving various complex problems, while here, if the needed capital cannot be procured on the coast, projects may be jointly financed by local as well as Eastern capital. This involves at the most, a trip East with none of the complications that go with the use of foreign capital.

The Pacific Coast is endowed with raw materials that may in time revolutionize some of the large industries; take for example oil so abundantly present in California.

Doesn't it seem like an intention of fate, that large high grade iron ore deposits, hydroelectric power and oil have been placed side by side. Can't you conjure up a new type of iron reduction process, where the iron is obtained from the ores by means of electric heat, combined with the carbon and hydrogen in the oil as a reducing agent? I feel certain that the day will come when the Pacific Coast will be a factor in the iron markets of the world, due to the presence of these three agents.

Norway has about 300,000 and Sweden practically 150,000 h.p. utilized in electrochemical and electro-metallurgical industries. This has not been grown over night, on the contrary they have done careful and faithful pioneer work, not only in the laboratories, but among the population, and also in the council chambers of the nation. An electrochemical atmosphere has been produced; the layman has been brought face to face with it in the perusal of his daily paper, and gradually the population has grasped the fact that (though the details were perhaps hidden to the layman), electrochemistry is one of those mystic shrines which, if approached with the proper signs known only to a few brings forth new developments and wealth.

We need an electrochemical atmosphere on the Pacific Coast. Gold mining has been the atmosphere. Everybody knows what a placer mine or a gold dredge is; the papers are full of it. The large state universities, as well as the daily papers, can assist in bringing this electrochemical atmosphere here. Without fear of being refuted, I will say that the Pacific Coast has more potential wealth in its eleven million horsepower, of which 93 per cent goes to waste today, than all the gold that ever was mined, or is still to be mined in these states.

Sweden and Norway are today looked upon as electrochemical centers. The Pacific Coast, I believe will, within the life time of most of us, be looked upon as one of the large electrochemical centers of the world, due to our being favored with abundant hydroelectric power, varied and important raw materials needed in these industries, and the men of this coast.

Electrochemistry is a young science in its present development compared with other sciences. The electrochemical industries are consequently young men's industries. Therefore young men are needed, men with the pioneer's optimistic resourcefulness and courage. But this alone is not necessary; they need a special education which the large universities of this coast are bound to give if they are not already giving it to their students. With power, raw material and men, the Pacific Coast holds a mighty future in the field of electrochemistry.

PUMPING PLANT TRANSFORMER EQUIPMENT.

By RALPH E. CUNNINGHAM.

(After pointing out the faults of early 10,000 volt indoor installations the author describes recent practice in outdoor substations. Mr. Cunningham is superintendent of electric distribution for the Southern California Edison Co., from whose magazine this article is reprinted.—The Editor.)

There have been a number of different methods used by the Southern California Edison Company for installing 10,000 volt equipment for pumping plants during the past years. The early installations were both of the indoor and outdoor type, but installed without much attention to "safety first." At that time very little experience had been gained to show the necessity of protection against the hazard of high voltage wires, and much the same methods of construction were used as had previously been used for low tension construction.

The rams horn fused air break switch was used for controlling the 10,000 volt line, both on the indoor

acter of the wires, would come in contact with them, both inside and outside the building. The first step taken to do away with this risk was to use cambric insulated weather proof wire in place of bare wire. In this case, however, the horn switch was still installed within the building, and while protected in so far as possible with wire screen, there was still considerable chance of accident on account of a fuse blowing under heavy load and the arc carrying up on the horns, setting fire to the building; also there remained the possible chance of persons coming in contact with the bare horn switches.

The next improvement was to substitute for the horn switches, a pole top fused switch, installed on the first pole outside the building. With this arrangement the operator of the pumping plant can disconnect his transformers and all wiring inside the building by operating the lever at the base of the pole which controls the pole top switch, even more easily than the pulling out of the three horn switches, which were previously installed inside the buildings to be accessible. With this installation the cambric insulated wire was still used for entering the building and within the buildings up to the transformers, so that under ordinary circumstances there was very little chance of any accidents. The only possible chance of trouble would be the breakdown of the transformers setting fire to the buildings, or irresponsible parties cutting into the insulated 10,000 volt wires.

All installations up to this time had been equipped with either two or three single-phase transformers. With a view to eliminating the objectionable features of the last mentioned indoor installation, also in the attempt to decrease the cost of the work, we have been trying out during the past season an outdoor type, three-phase transformer.

The use of the three-phase transformer in large units for main station and substation installations has become a common practice, but the three-phase transformer in small units for distribution purposes has not come into general use. This, no doubt, is accounted for by the fact that a three-phase transformer can only be best used where a strictly power load, or other balanced three-phase load is to be supplied.

After a rather extended investigation, conjointly with the manufacturers, a transformer was decided upon, having a Y-Y winding. Certain taps were desired on the high tension side of the transformer, as well as double voltage arrangement for the secondary side of the transformer, and the Y-Y windings allow these arrangements in the simplest manner. The high tension winding is ungrounded; the neutral point of the low tension winding is grounded, as a safety measure. The usual connection of the secondary coils is for a 460 volt service, although two secondary coils are provided on each leg of the transformer, so that a 230 volt service can be obtained if desired. With a ground at the neutral point it is impossible to obtain a voltage in excess of 266 from any secondary line wire to ground. In most cases a few lights are required around the pumping plant and to furnish this service a tap is brought out from a winding on one leg of the transformer to supply 110 volts to the ground connection. Transformers of this type are being made for us in sizes from 10 to 100 kilowatt.



Fig. 1—An Early Type of Indoor Installation.

and outdoor installations. The trouble experienced with the outdoor installation was on account of the fact that no standard outdoor type bushings were manufactured in the early days, and the ordinary bushings on the outdoor installations gave a chance of grounding the lead-in cables, due to dirt and damp weather; also the small fuses used in the horn switches would often break off due to birds or the weather.

Fig. 1 shows the exterior view of a typical indoor installation. The faults of the early type of indoor installations are obvious to the "safety first" advocate. The bare high tension wires, while installed at a height above ground which might be thought would ordinarily prevent trouble, were the cause of a number of serious accidents. Owners occasionally desire to paint their buildings or do other work around the building and not understanding the dangerous char-

Shown by Fig. 2 is a typical installation of 30 kilowatt three-phase transformer. The high tension line is controlled by pole top air break switch, operated from lever at the base of the pole. On the same mounting with the switch are fuses, consisting of three-quarter inch ($\frac{3}{4}$ ") Bakelite tubes, 12" long, in the center of which is placed the fuse wire, and the space filled with plaster of paris. With this arrangement the transformer is disconnected by the customer at times when the plant is not in operation and thus unnecessary core losses are prevented. In case it becomes necessary to replace one of the high tension

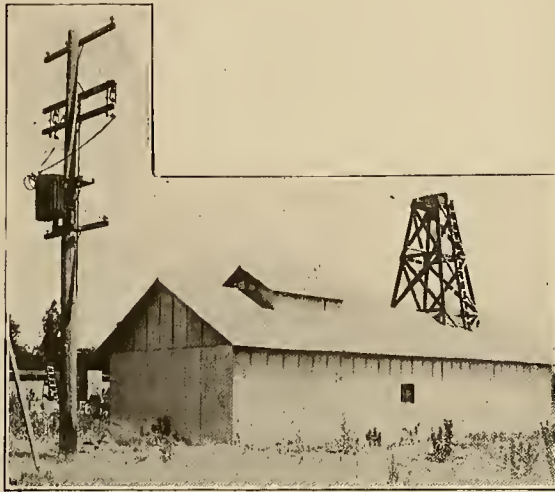


Fig. 2—A Typical Installation of 30-Kilowatt Three-Phase Transformer.

fuses, the switch is opened by the troubleman, before climbing the pole, so that he is not called upon to work on energized apparatus.

There is a saving to the company of from \$25.00 to \$50.00 on each installation by using the outdoor three-phase transformer, rather than installing the single-phase transformers within the building. In addition to this, there is a saving to the customer, as he does not have to furnish the extra space and foundation for the transformers within the building.

In converting an old gas engine plant to electric drive it is unnecessary for the customer to include any expense for extending his building, as would be required for an indoor installation. This extra expense might influence the consumer against displacing his engine.

Fig. 3 shows a recent outdoor installation of three 50-kw. transformers. Installations of this capacity are somewhat unusual, and we have not as yet considered the three-phase transformer in size above 100 kilowatts. The picture serves to show how much more complicated the connections, both high and low tension, become for installations of three single-phase transformers compared with the single unit three-phase transformer.

From the standpoint of general appearance, the indoor installations are more pleasing than the outdoor installations, even when simplified with the use of three-phase transformer mounted on a single pole;

it is only when "safety first" is considered that the outdoor installation "looks good."

One of the features of the present methods which is not entirely satisfactory, is the use of protective high tension fuses. We have had cases where one of these fuses would blow, leaving the motor operating single-phase, resulting in the burnout of the motor or the transformer. If some reliable automatic three-pole switch could be devised, cost of which would not be prohibitive, the installation, I believe, would be much improved.

The use of steel poles on which to mount the transformer and switch has received some consideration on account of the possibility of the wooden pole



Fig. 3—Outdoor Installation of 3-50 K. W. Single-Phase Transformers.

being burnt down by brush fire or faulty insulator, but on account of extra cost we have not as yet proposed any installations of this kind. It might be advisable, however, to utilize the old tripartite steel poles which are being removed from transmission lines in case a better place is not found for them.

"Electric piano week" is to be aggressively advertised March 13-18, 1916, by a committee representing various manufacturers of electric pianos, electric motors and the Commercial Section of the National Electric Light Association.

Powdered coal is being tried in an experimental way in the smelters of British Columbia as a means of utilizing low grade coal and getting better efficiencies, the coal being finely crushed and sprayed into the furnace with compressed air, somewhat as oil is fired. This method is also being tried out in locomotives and in steamships.

REPORT ON THE COLUMBIA POWER PROJECT.

BY L. F. HARZA.

Appendix G—Problem of Flood Control.

(Concluded.)

Tainter Gate. As an alternative to the Camere dam there has been studied the feasibility of a large tainter gate closing an opening of the same size. This has been assumed as reversed from the usual direction of water pressure for a gate of this type in order to permit the load to bear downward upon the pier instead of upward and for any advantage gained by putting the principal members in tension. A general drawing of this gate is shown in Fig. 38.

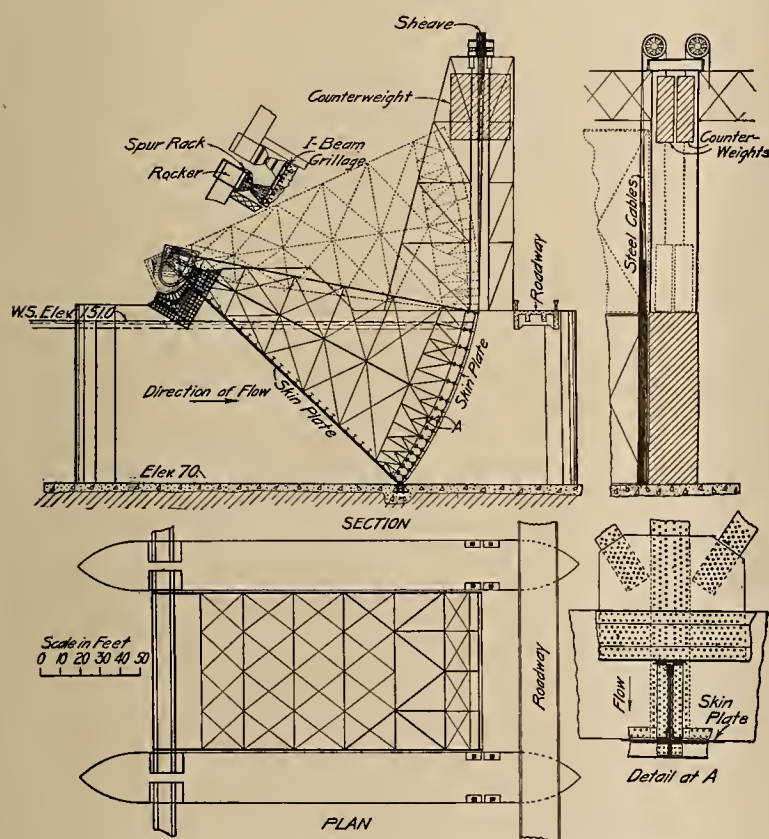


Fig. 38. Reversed Tainter Type of Removable Dam.

A skin plate would be provided along the arc of the gate as shown in the detail. To avoid putting the rivets in tension, the I-beam stiffeners would be placed in a vertical position on the downstream side of the skin plate and framed into the extended webs of horizontal girders about 4 ft. deep, spaced to suit the pressure. The entire width of the gate, 80 ft., would be divided into 4 panels by vertical diaphragm plates, into which the above girders would frame, these plates forming a part of the tension chords of vertical trusses which would transmit the reactions of all the girders to an upper, a lower, and a medial horizontal truss, these trusses (shown in plan) being in a radial plane and having their end posts extended to meet at the central axis. The axis would consist of several heavy plate girders extending at the ends beyond the limits of the gate and into the bearing on the pier.

The bearing would consist of a rocker built as a large ribbed steel casting having a convex rolling surface 10 ft. wide and curved in the form of a spiral. The axial girders would project from the gate into and

through this casting. This rocker would roll on a concave surface of another steel casting also 10 ft. wide. The latter casting would be built as an inverted conical pedestal with lower flat contact surface resting upon the long radius convex surface of another conical pedestal, which in turn would rest on an I-beam grillage imbedded in the concrete of the pier. The lower pedestal would probably be built in two or more pieces, as shown, to reduce the size of a single piece.

The concave casting is thus made to tip laterally to permit its adjustment to the deflection of the cantilever ends of the axial girders and thus prevent the concentration of the load on the inner edge of the bearing. To permit this casting to tip freely it is supported at its lower end on a nest of rollers arranged radially with the arc of tipping. The concave rocking surface would be so designed as to be normal as nearly as possible at all positions, to the direction of the resultant of water pressure and dead load so that the rocker would have the minimum tendency to slide tangentially along the concave surface. Any such remaining tendency would be overcome by means of large spur racks along the outer edges of both rocker and rolling surface, designed to mesh with each other.

Both the loads between the rocker and its concave supporting surface and between the two conical pedestals would be resisted theoretically along a line. In the choice of radii for these castings the precedents established by similar pedestals in steel bridge construction were followed. The reduction in water pressure against the gate as it is raised permits the use of a decreasing radius or a spiral for the rocking surface.

The gate would be counterweighted by cables attached to the lower edge on the downstream side and running up the face of the gate and over sheaves on the top of high operating towers to a set of eveners and then to the concrete counterweights within. Grooved castings in which the cables would lie, would be provided up the face of the gate. As shown in the sketch, the plane of the cables is warped 90 degrees between the drum and the face of the gate. This would require that the cables be spaced wider at the bottom of the gate to prevent them from touching in the middle. If preferable, two sets of eveners just above the gate, and set at 90 degrees with each other, could be used to rotate the plane of the cables, and the eveners above the counterweight could then be eliminated.

The total load to be lifted would be about 2000 tons which would require at each end of the gate about 16 plow steel cables of $2\frac{3}{4}$ inch diameter and sheaves 14 ft. in diameter.

The reversal of the tainter gate from its usual position is objectionable in that many large and small steel members of the entire structure would be submerged and subjected to a large load from the dynamic pressure of a high velocity of water, if discharging with the gate only partially raised. These stresses would be very large, as learned from the studies for the Camere dam. In the winter season, ice would at times form around

the many steel members where they emerge from the water and the gate could not well be lifted without first cutting out the ice to prevent it from injuring the smaller members by breaking loose and falling, after raising the gate. The first objection has been met by providing the whole lower plane of the gate with a skin plate through which many holes would be provided to equalize the water levels while raising and lowering the gate.

In the tainter gate scheme of control only two roller dams have been provided, these to be used for drift and ice sluices on the Oregon side. This makes it necessary for the tainter gates to operate at varying openings for the close regulation of head and discharge. This would not be practicable when ice or drift were running, as the velocity of approach to the gateway would be very high; heavy drift would collide with the lower skin plate and in sucking under the partially opened gate would further endanger this skin plate and also the downstream face of the gate, should it remain in the destructive eddy which would form above the zone of discharge. It is therefore believed that the satisfactory operation of this gate is also dependent upon the successful diversion of drift and ice by a boom, although perhaps not as vitally as with the Camere dam.

The gate here proposed is of course far beyond any precedent for structures of its class. When compared with large bridges, in which the stresses cannot be as definitely computed as here, the same cannot be said. Many individual bridge members can be cited with stresses greater than in any member of this gate.

It is believed that the heaviest lift bridge span thus far built is that of the O-W. R. & N. Company bridge in Portland, Oregon, the weight of which is 1700 tons, and is lifted in much the same manner as proposed for this gate. The lifting of the greater weight here proposed does not change the nature of the problem except insofar as the cables must be concentrated into a narrow width on the gate and on the sheave above instead of being spread out by two or more sheaves as they can be along the end of a bridge span. This difficulty is not believed to be insurmountable.

The large bearing here proposed is sustained by the least precedent perhaps of any feature of the design. The elements of this problem are again however not novel in most respects to large bridge structures. The concentration of an immense load along a straight line by means of a conical webbed casting and the subsequent distribution of this load by such a pedestal to a safe working value for concrete has often been accomplished, notably in the new skew-backs of the Hellgate arch, (Engineering Record, August 22, 1914, page 216), where a load of 30,000,000 lb. was thus concentrated, about three times the load to be taken by one bearing of the proposed gate. A heavy web 8 in. thick was there provided in the pedestal immediately beneath the line of contact with three inch webs elsewhere. The fact that our line of contact must travel along the rocker, being alternately above and between the supporting webs, introduces the new problem of carrying the load as a beam between webs with sufficient strength along any line of contact to support the load. This will require a

thick flange for the rolling surface and closely spaced webs.

A study has also been made of the adaptability of an ordinary roller bearing for which there would be required 29 rollers each 12 in. in diameter, rolling in a race of 20 ft. outside diameter, the outer casting being a conical pedestal similar to the concave rolling surface previously described and provided to rock in the same manner to avoid concentration of pressure at the inner ends of the rollers.

Time has not been available for a complete solution of the problems of this gate and bearing. The feasibility of the main members of the gate proper have been assumed, without attempt to design them, based upon the fact that larger members are in use elsewhere. Their weight has been estimated from their loading, and an assumed unit stress. The smaller diagonal braces and the effects of many secondary stresses have been allowed for only by rough approximations and by a contingent weight.

While not being finally committed to the entire feasibility of this gate, particularly the bearing, yet it is believed that the problems involved are not insurmountable.

Comparisons. Of the two schemes, the Camere and the tainter gates, for the removable dam here proposed, the former represents nearly the extreme limit to which it is practicable to subdivide the structure for the purpose of minimizing the loads to be handled in operation; the latter probably represents nearly as close an approach to the other extreme.

The Camere dam would be the more expensive to operate because of the multiplicity of parts to be handled, the necessity of greasing many bearings, the need of much maneuvering of the crane in the handling of the gates, girders and chains, with the attendant annoying difficulties. On the other hand that it would be much cheaper to construct should be evident, due to the fact that two-thirds of the water pressure against the dam is conveyed at once to the foundation instead of being carried by a complex system of trusses to a costly bearing, and also due to the fact that but one operating crane would be required and that to lift only 200 tons instead of individual equipment of much greater capacity. The simplicity of operation of the tainter gate nevertheless commends it strongly even at greater cost.

Neither design has been carried out to its last analysis, but the Camere type has been much more completely studied, as it was started first. In its study the complete general designs and analyses of the dams of this type on the Panama Canal were available, which greatly reduced the labor and to some extent contributed to the work the benefit of the vast amount of study which was given to this problem by the engineers of the Isthmian Canal Commission. It is also somewhat reassuring to have the benefit of the precedent thus established, in proposing a structure of this type, even though the structure here proposed is considerably greater in magnitude.

The problem of erection is much simpler, quicker and less hazardous in the case of the Camere dam. Everything except the overhead trusses could be fabricated completely in the shop and shipped ready to merely lift into place. The erection of the overhead trusses could proceed regardless of the stage of the

river, without falsework and without danger from high water, which danger would affect only the setting of the lower girder seats. The erection of the tainter gates would be accompanied by some risk. The gate seat is at 70.0, the normal elevation, for a flow of 100,000 second feet. The form of the tainter gate necessitates very elaborate and expensive falsework for its erection as well as much field riveting and calking. The erection period would be long and a gate would need to be completed with towers, cables, sheaves and counterweights before it could be raised out of danger from possible high water, which might do great injury to both gate and falsework if only partly erected.

Conclusions. While the studies of neither type of dam have been completed, yet it is believed that they, especially the Camere, have been carried far enough to solve the main problems bearing upon the feasibility of constructing and operating dams of these sizes, as well as to furnish the basis for a reasonable estimate of cost. Should a concrete dam across the narrows ultimately be adopted, the controlled depth would decrease from 80 ft. to about 60 ft. and the structures be brought much closer to precedented sizes.

It is probable also that in the final design of the project it will be found possible to decrease considerably the controlled depth as used herein even with the use of a rock fill dam. The designs of these struc-

tures were nearly completed to their present state before the study of probable frequency of extreme floods as shown in Fig. 18 was available and in which it is shown that the flood of 1894 is probable only at very rare intervals. The flood of 1,400,000 second feet as used herein, was adopted partially as a margin of safety to allow for greater floods, which purpose could probably now be eliminated, thus increasing the head available for flood discharge from 7 ft. to 11 ft. and decreasing the depth of control to about 62 ft. The large flood was assumed partially however to allow for a possible error in the estimate of the flood of 1894, which error might easily equal or exceed 10 per cent in either direction; also to allow for possible errors in the estimate of the river elevation at gages 2 and 3, the tailwater of the flood channel; also in the headwater record of 1894, and errors resulting from lack of hydraulic data applying to the proposed flood channel. The final design should include an experimental study of the hydraulic coefficients of headworks such as proposed, and daily records of the elevation of gages 1, 2 and 3, should be kept during each high flood such as that of 1913, from now until the final design is made.

It is believed that some reduction in controlled depth is justified at this time. The records as shown in Fig. 34 indicate a drop in 1894 between gage 1 and gages 2 and 3 of about 12 ft. If this be reduced to 11 ft. to allow for possible errors in gage heights;

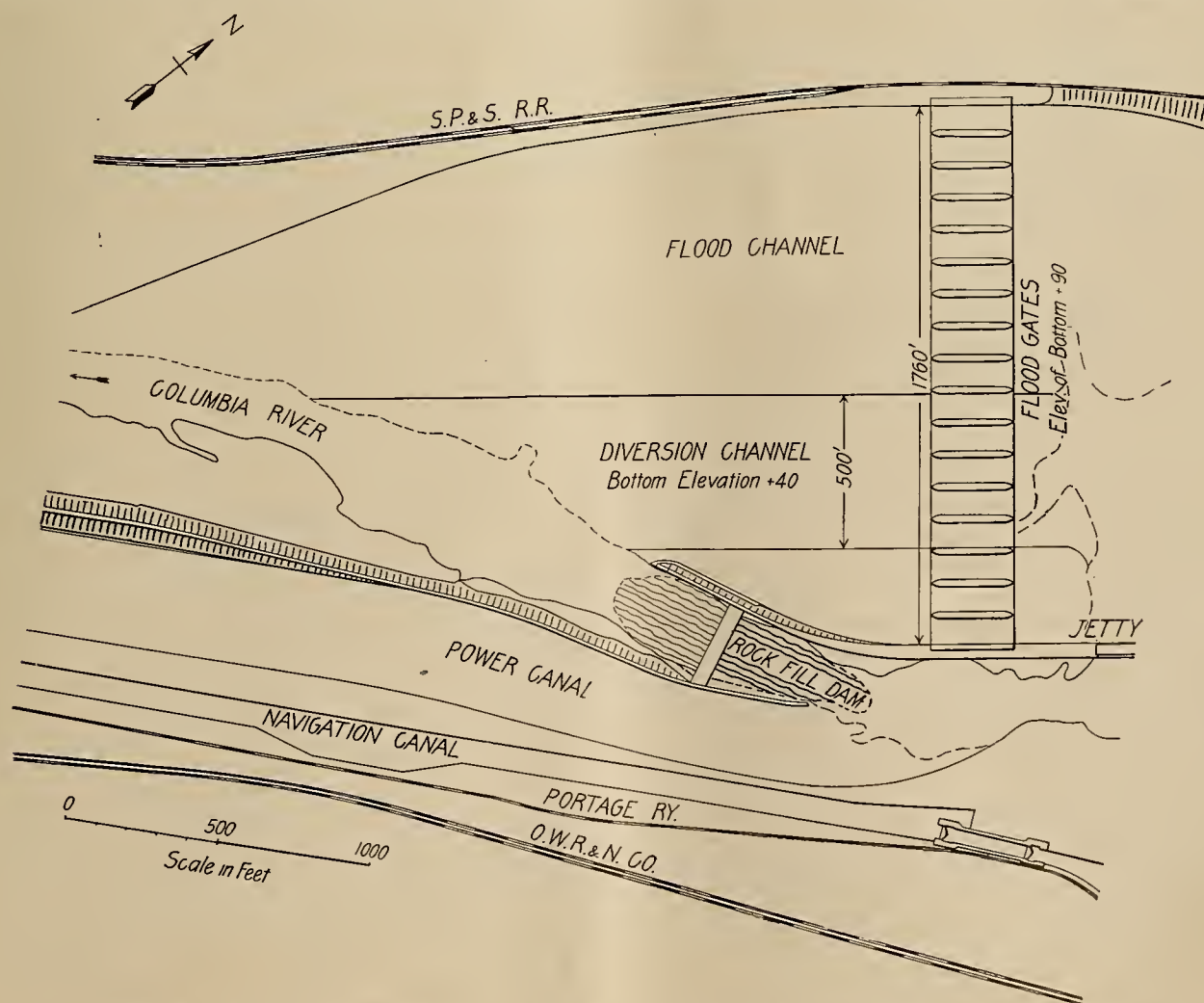


Fig. 39. Possible Alternative Arrangement of Headworks, Transferring Canal and Power House to Oregon Shore.

and if it be then assumed that the estimate of the discharge in the 1894 flood, obtained by extending the rating curve, Fig. 12, is 10 per cent too small or that the actual discharge was 1,290,000 second feet; then the bottom of the flood channel would be raised for the rock fill dam as shown in Fig. 35 from elevation 70 ft. to elevation 84 ft., and for the concrete dam with flood gates, shown in Fig. 36, from elevation 90 ft. to elevation 100 ft.

In addition to the above causes which may permit an ultimate reduction in the controlled depth, it should be said that another possible layout of the entire project, conducing to this same end, was conceived too late to be considered in detail in this report or in the estimates of cost. The headworks of this scheme are shown in Fig. 39. The dam would be built below the deep pool or about 1100 ft. below its former location. The power canal would originate on the Oregon side of this pool and could be made to clear the present navigation canal by using a concrete river wall and a narrow initial section with bottom elevation below the river bed to be excavated behind a natural rock cofferdam. The power house would then be located on the Oregon side of Big Eddy (see Fig. 9) between the lower locks of the navigation canal and the main channel of the river. There are important objections to this layout as regards the location of the power house and canal and their effect upon the flood capacity of the river. Much study, including soundings at the proposed damsite and at the lower end of the rapids, where the water enters Big Eddy, would be required to determine the feasibility of this scheme. It is offered as a suggestion for future consideration, as it would leave available for flood gates the entire bench to the right of the damsite and would thus decrease the necessary controlled depth to about 60 ft. for 1,400,000 second feet, or about 50 ft. for 1,290,000 second feet.

STIMULATING PUBLIC INTEREST IN THE WATER POWER IMPASSE.

The February 9th issue of "The Outlook" contains an excellent article on the unfortunate conditions as regards water power development. The author, Hugh L. Cooper, engineer for the Keokuk plant on the Mississippi River, presents the subject so cogently that a few extracts seem desirable. After showing the difficulties that engineers have overcome and emphasizing the need for the development of our wasting water powers, he says:

The average cost of a water power per horsepower may be taken at about five times that of steam, and in addition the difficulties in raising money and the cost of money for water powers are much greater than for steam, because the steam plant is free from flood hazards in construction and operating periods, and it can be constructed in small units about as the market requires, whereas the water power usually has to be greatly overdeveloped and then wait for its market to grow up to it, thus entailing large additional interest costs while securing and waiting for business. The water power requires for operation about one-fourth the amount of labor that steam power requires. Therefore the water power conserves labor as well as coal.

About the time that engineers had learned their lesson and were able conservatively to design and estimate water power plants, and about the time the optimists and com-

mercial men had learned that it is necessary to sell hydro-electric power for about sixty-five per cent of the cost of steam power, along came a wall all over the United States because, it was said, a so-called water power trust was robbing the people, and then began a campaign in Government circles and in magazines that reduced the water power industry to its present state of innocuous desuetude.

Any intelligent truth-seeker who has honestly investigated the subject has found that no water power trust exists now or ever has existed, and furthermore, never can exist in the face of a steam competition which no aggregation of capital could possibly control; that no banker is seeking investment in new water projects; that practically every banker who has ever made an investment of this class for his clients will recite a hard luck story of disappointed expectations and hopes; that the market has been flooded with prospectuses and reports on projects which no substantial investment interest will take up because of the present general unpopularity of water power securities.

It is stated by some who oppose changing the present laws for development of water power on public lands that there is no necessity or demand for additional developments in the West, because some existing power companies have sufficient power unsold to supply the present and near future market. The suggestion by Government officials that great areas of territory in the West and South shall be deprived of industrial growth through water power assistance until these few restricted districts have consumed all the developed power is so unfair and unsound economically as to be almost pitiful. Our railways had to overdevelop that the country might develop, and the same is true of the water power industry. It can also be said that in the entire United States today there is not a single water power developed that can offer power terms justifying the establishment of fertilizer works, electro-chemical works, large irrigation projects or nitrogen fixation plants. It can also be said that there are now tentatively under serious consideration in the United States new developments that will call for more than \$75,000,000, all waiting for encouraging legislation only. Must our unnecessary importations, amounting to \$50,000,000 a year, and many other crying needs, wait until a few Western plants can sell out a small amount of power now unsold? I do not think the people will take kindly to this idea. Furthermore, if it should turn out in the future that more power is developed than can be immediately sold, such a condition is hardly one which the public or the Government need worry about, so long as the people reserve to themselves the right to regulate power rates.

Another little-known fact about water power that bears upon the question with peculiar force at this time is the one of profit in water power investments. Steam competition has driven the prices for power lower and lower for the past twenty-five years, and while the cost of practically every other human necessity has been mounting upwards each year, the cost of power has been steadily going downward, and this process was strongly established long before state public utility commissions were created. For water powers to compete with these steadily declining steam costs has been very difficult. In 1912 over five thousand power stations investigated by the Department of Commerce showed that the steam stations were earning a surplus of 4.1 per cent above fixed charges, and the water power companies were earning only 1.78 per cent. This 1.78 per cent showing is a fine tribute to the financial genius and grabbing results of the alleged water power trust. Investors will not be attracted to securities afflicted with strong competition and many and great risks, legal, commercial and physical, for a surplus anything like as low as 1.78 per cent; and the reason for their attitude is easily found in the fact that the investors can go into many other safer fields and make much more.

THE DIESEL ENGINE IN PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

Diesel Applied to Marine Purposes.

The beginning of the application of Diesel engines for mercantile ships was made in Russia on the river Volga and the Caspian Sea. They were designed for ships owned by the firm of Nobel Bros. in Petrograd and were partly built in their own shops and partly at the Kolonna Works in Moscow and at the Swedish Diesel Engine Company in Stockholm.

These new marine engines were first built in Russia for two reasons: First, because there are large oil wells at the Caspian Sea, whereas other fuels are expensive in that vicinity. This brought, therefore, the first stationary engines from the Maschinenfabrik Augsburg-Nurnberg at an early time to these countries. But, that cheap oil and expensive coal does not necessarily lead to the early adoption of marine Diesel engines is demonstrated on the Pacific Coast of the United States in regard to stationary engines, where circumstances are similar in this respect.

The second factor was the progressiveness of Nobel Bros., who, being owners of oil fields, as well as of ships and engine works, had everything in their possession necessary for the realization of their plans in this line.

In this way there existed in Russia several marine Diesel engines long before the rest of the world earnestly considered the manufacture of such engines. The construction, however, was mainly the same as of the standard stationary engines of the Nurnberg type with slight changes. But, when observing the present day big Diesel engines for sea-going ships, it is noticed that the valves and valve gear are copied from the original stationary engines; otherwise they are different in many ways. After the engines of Nobel Bros. a few small marine Diesel engines were turned out in 1910 by Sulzer Bros. of Winterthur, and the Maschinenfabrik Augsburg-Nurnberg, known in their country as the Nurnberg Company. These engines were high-speed, box frame engines of comparatively low power. They did not yield much satisfaction in continued service, being much of the type of light weight submarine engines.

Up to 1910 all marine Diesel engines were designed with the long trunk piston in which the wrist pin was fixed, to which the connecting rod was fastened. In 1910 for the first time, a box-shaped piston with piston rod, cross-head and guide was introduced in place of trunk pistons and are now used in almost all types of marine Diesel engines. At this time there was also applied the four tie-rods around each cylinder coupling most directly the upward forces due to the pressure on the cylinder heads and the downward forces on the main bearings due to the pressure on the pistons. By these means it became possible to keep the cast iron frame in which the connecting rods move, very light and to provide for big apertures, as this box-shaped frame had to carry the weight of the cylinder only, no forces being transmitted through it.

After the small Diesel marine engines, the six-cylinder engine of the "Vulcanus" was the first full-powered reversible Diesel engine, shown in section in Fig. 28. This engine had a capacity of 450 b.h.p. at 180

r.p.m. The cylinder was 15.7 in. in diameter and 31.5 in. stroke. The ship is of 1000 tons, owned in Holland. The hull and engine was built in Amsterdam; it was ordered in 1910 and in December of the same year the trial trip took place.

In the beginning trouble was encountered with the air compressors and also through the lack of experience of the engine attendants. The ship has, however, completed successfully every voyage undertaken, among others a trip from France to Singapore without an extra stoppage at sea, and it is in permanent service in India at present, to the full satisfaction of the owners.

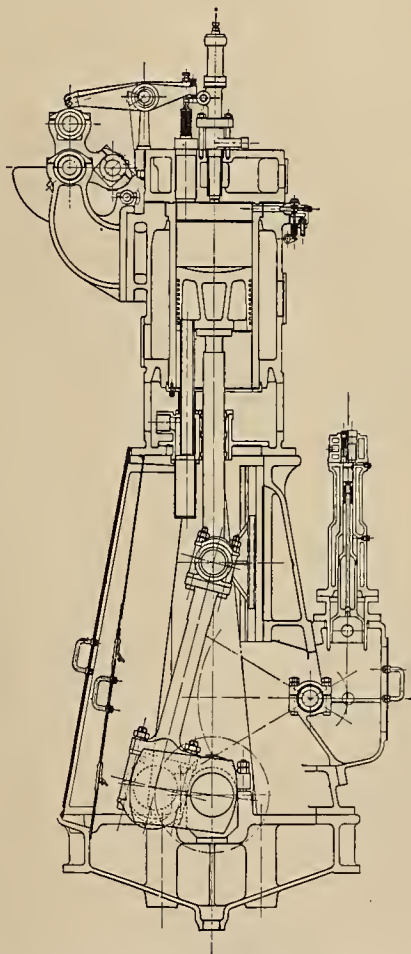


Fig. 28. Six-Cylinder Werkspoor Marine Diesel Engine of the "Vulcanus," 450 b.h.p.

The engine of the "Vulcanus" is directly reversible, there being two cam-shafts, one with cams set for forward motion, the other for backward motion. The hand-wheel for the reversing is mounted on a handle case, where all the operations necessary for starting, reversing, regulating and stopping can be controlled. The valves and levers in the cylinder heads do not differ from what is ordinary practice for four-stroke-cycle stationary Diesel engines.

The fuel pump shows an interesting feature. There is only one pump and one spare pump for the whole engine. The oil is pumped into an accumulator, which stops the pump when full by keeping the suction valve open. The "Vulcanus" is now plying between the East Indian Islands, making short trips.

There is inserted here a comparison made by the marine superintendent of the Anglo Saxon Petroleum

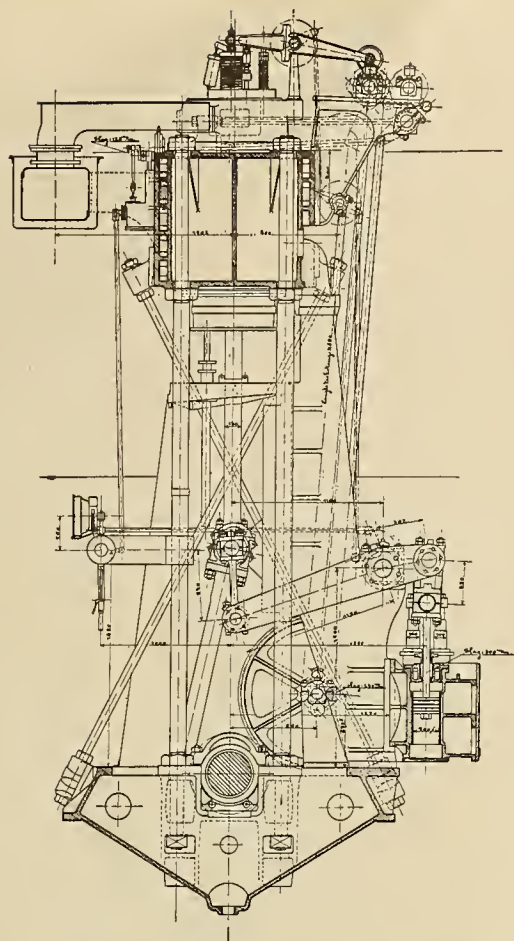


Fig. 23. Werkspoor Marine Diesel Engine, 1100 b.h.p.

Company, the following comparison showing the result of two years' actual working with the Diesel Ship "Vulcanus" and the S. S. "Sabine Rickmers" using coal:

	"Vulcanus"	S. S. "Sabine Rickmers"
Length	196 ft. 0 in.	200 ft. 0 in.
Breadth	37 ft. 9 in.	30 ft. 6 in.
Draught	12 ft. 4½ in.	16 ft. 9 in.
Deadweight—		
Carrying capacity.....	1235 tons	1269 tons
Displacement	2080 tons	2290 tons
Engines	6 cylinder reversible	Triple expansion

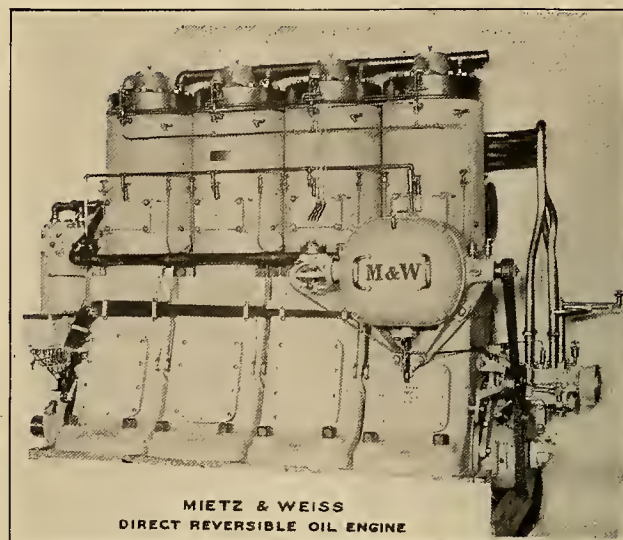
The following economic results have been shown in service:

	"Vulcanus."	S. S. "Sabine Rickmers."
Total running time on voyage.....	8.26 days	7.04 days
Total distance	1530 miles	1473 miles
Mean speed	7.7 knots	8.7 knots
Average oil consumption per day of 24 hr.	2.06 tons	13.4 tons
Cargo	976 tons	1013 tons
Dead weight	1112 tons	1225 tons

A striking example of the advantages associated with low fuel consumption is to be found in the fact that the "Vulcanus" recently completed a voyage of eighty-eight days without bunkering at any intermediate port. On this particular run she left Europe in August with 140 tons of fuel oil in her bunkers and returned in November, covering a distance of some 10,750 miles. Nevertheless, six tons of liquid fuel remained on board after the completion of the voyage. Thus the total consumption was 134 tons in 65.7 operating days or 2.03 tons per diem.

The "Vulcanus" held for the full year the place of being the only full-powered Diesel ship afloat, from the end of 1910 to 1911, when the "Sembilan" was con-

structed. This vessel had a comparatively small engine of 200 h.p. in three cylinders, the engine being



Typical American Marine Engine.

reversible. This vessel proved very successful and is at present running to the East Indies, the owners having since ordered five engines for larger vessels.

(To be continued.)

LETTERS TO THE EDITOR.

Importance of Plain Writing.

To the Editor—

Sir: I have just now read the editorial on the "Importance of Plain Writing" in the February 12th issue of the Journal. I have done this with much interest and profit to myself. We realize the responsibilities of the engineering colleges with regard to English for engineers. An editorial such as this one constitutes an important moral backing for us in our efforts to meet these responsibilities with improved results of the sort you indicate so clearly to be highly desired.

Cordially yours,

HARRIS, J. RYAN,

Professor of Electrical Engineering.

Stanford University, Feb. 11, 1916.

To the Editor—

Sir: I want to congratulate you on the editorials in February 5th issue of the Journal on the "Decline of Water Power Development," and also on "What is an Engineer?" I think you will find that the teaching faculties of the various colleges are more keenly aware of the truth of this analysis than your editorial would give us credit for, and the thing that prevents the immediate adoption of these principles in our engineering education is the fact that unfortunately we are forced to give education in some degree that the public who pays the bills thinks it ought to have. So then it is a question with us of educating the public into accepting what it ought to have.

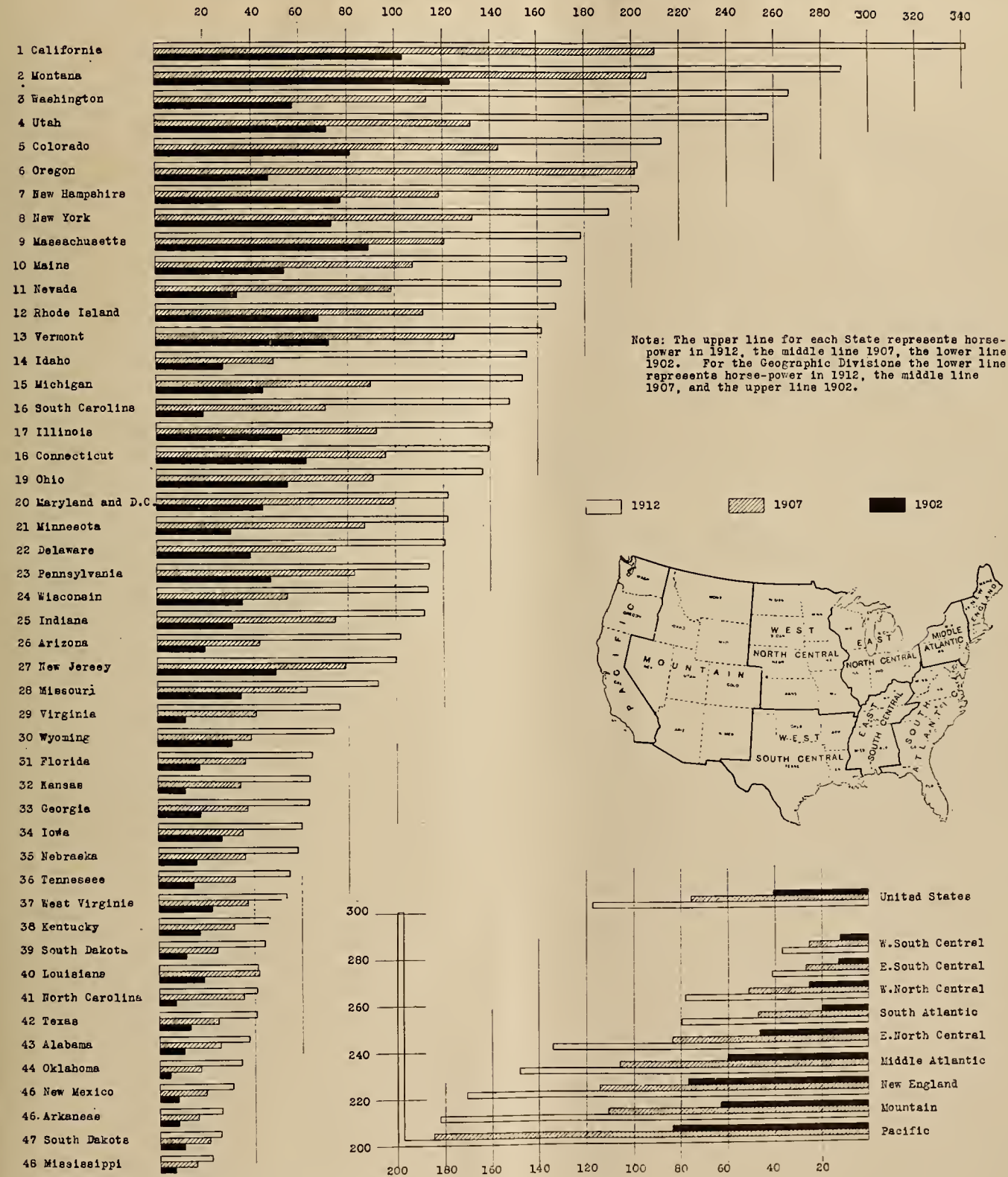
Very truly,

W. D. PEASLEE,

Department of Electrical Engineering, Oregon Agricultural College.

Corvallis, Ore., Feb. 7, 1916.

PRIMARY POWER USED IN U. S. PER THOUSAND OF POPULATION.



To accompany report on Sen. Res. No. 544, 63rd. Cong., 3rd. Sess.

JOURNAL OF ELECTRICITY

POWER AND GAS

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Ten thousand electric ranges can be sold in the West during 1916. One central station has put two hundred new ranges on its lines during the past six weeks, another has put on three hundred within three months and a third added over six hundred cooking consumers last year. Other companies are just starting similar campaigns. At rates of four cents per kilowatt hour, or less, for this class of service, the revenue averages about one dollar per month per person. This means that fifty thousand dollars a month income can be added to existing power lines.

The efforts to interest consumers in electric cooking are mostly being carried on in territory not supplied with gas, though some companies are finding little difficulty from such competition. The usual method has been a house-to-house canvass co-operatively conducted by manufacturers and central stations, though some companies are wisely enlisting the aid of electrical jobbers and dealers. At best, such methods are necessarily slow, as they involve individual introduction and personal creation of demand, whereas a judicious advertising campaign would pave the way for the salesman and effectively supplement his work.

Now that electric cooking is a demonstrated success it is time to start an intensive local advertising campaign proclaiming the advantages of the electric range. No one will run around turning on individual electric lamps when he can control all of them with one master switch. Advertising, in this case, is the master switch. The general educative advertising might well be initiated by the several manufacturers. Then the local power companies and dealers can tie in with it, linking their intensive sales talk with the more general extensive publicity.

The best mediums to carry on this campaign would probably be the country weeklies and farm journals, as the small towns and farming districts are most frequently without gas service and the people more easily interested. This would be more economical and less wasteful in circulation than advertising in mediums of national circulation, many of whose subscribers in the East and in the large cities would not take advantage of this opportunity.

Here is need for immediate action. Should this suggestion meet with approval the new business managers of every power company west of the Rocky Mountains should write to the manufacturers of electric ranges requesting that this campaign be started at once. Here in the West where from eighty to ninety-five per cent of the houses along existing lines have already been wired, there is no need for a house-wiring campaign. But there is urgent need for increasing the day load, a need which is admirably met by the electric range.

The report of the electric range committee of the National Electric Light Association indicates that this is a most desirable load for Western companies. The report represents the serious effort of broad-minded, thinking men. Their recommendations are worthy of careful consideration and some campaign should be started to cash in on the opportunity that is here presented.

The electrochemical industry has long been a vague possibility as a consumer of hydroelectric energy on the Pacific Coast. Recent changes in sources of chemical supply have converted many of these latent possibilities into active probabilities. Consequently a peculiar present value attaches itself to the expert estimates made by J. W. Beckman elsewhere in this issue.

His analysis shows that its abundant raw materials give the Pacific Coast an advantage over other electrochemical centers. Great quantities of limestone are cheaply available for the manufacture of calcium cyanamide and calcium carbide and the smelting of ores. Large deposits of iron, copper and zinc ores are found in many localities.

The tremendous production of California fuel oil supplies hydrogen and carbon as reducing agents. This carbon, in the form of briquetted lamp black, now almost a waste by-product in the manufacture of gas, is in many respects superior to the charcoal which has made Swedish iron famous. The Pacific Coast likewise has more standing timber adapted to charcoal manufacture than Norway and Sweden. The elements used in the manufacture of alloy steel, tungsten, chromium, manganese and silicon are all mined on the Coast and shipped East.

Mr. Beckman likewise shows that electric power can be generated as cheaply in the West as anywhere. Labor is but slightly higher and to some extent can be replaced by mechanical power. Furthermore, one unfortunate effect of the European conflict has been to deplete the number of able-bodied workers, so that European and Eastern labor costs will undoubtedly tend to approach those found in the West.

All these facts point to the likelihood of a greatly increased electrochemical activity on the Pacific Coast within the next few years. Powder manufacturers, who have a number of large plants in California, are already installing equipment to harvest and treat kelp, the latest plant being that of the Hercules Powder Company at San Diego. Large scale experiments are being made on air-nitrate production, with good promise of bettering the low efficiencies found in European plants.

The greatest permanent opportunity, however, seems to lie in the manufacture of fertilizer to supply the three essentials of plant growth, nitrogen, potassium and phosphates. Nitrogen constitutes four-fifths of the air we breathe; potassium makes up one-fifth, by weight, of the giant kelp beds which cover an area of about four hundred square miles along the coast of Washington, Oregon and California, and also is found in several natural salt deposits, and rock phosphates are abundant in Idaho. There is a heavy demand and good prices for mixed fertilizers, so that every inducement is offered to embark on their manufacture.

Electric smelting of iron ore is also an attractive proposition, though the initiative in the matter will probably come from the steel trust, which controls most of the extensive deposits of iron ore in California. A variety of causes which contributed to the failure of the Noble Electric Steel Company at Heroult, California, could be avoided in future work in this direc-

tion. The possibilities of progress are indicated by the fact that the total amount of pig iron from electric furnaces throughout the world is but little in excess of that produced by one modern blast furnace. Electric steel furnaces are now an assured commercial success, and a number will be installed in Pacific Coast foundries this year.

Electric copper smelting, like electric zinc smelting, is commercially feasible, though still in the experimental stage. Experimental smelting of the copper ores of Shasta County, California bids fair to solve some of the metallurgical difficulties of the past. Electric zinc smelting is being tried out in a small way also in the Northwest, the great difficulty being the condensation of a blue powder instead of a metal, due to the high speed of smelting.

Several investigators agree that aluminum manufacture is not likely to flourish in this locality for some years to come. Bauxite, the basis of the present process, is not known to exist in the West, and processes for the extraction of alumina from Utah alunite are still in the laboratory stage. Some chemist in the future will solve the problem of unlocking the tremendous stores of aluminum and potassium which occur in feldspar, but this is still a dream, as far as demonstrated practical results are concerned. Aluminum is the most abundant metal in the earth's crust and one of the most difficult to separate from its compounds.

The processes thus far suggested employ the high heat of the electric arc as the chief means of bringing about new chemical combinations or separations. While these methods are more spectacular, they have not been applied as much in the West as the electrolytic methods employing direct current. Electrotypers, electroplaters and metal refiners consume considerable current, and recently a large company has been incorporated to manufacture caustic soda and bleaching powder in a plant to be erected at Pittsburg, California. Bleaching powder is also manufactured extensively at Oakland, California, by the electrolytic process. Electrolytic production of zinc is also a recent development, a plant now being installed in Montana.

The fly in the ointment as regards the immediate materialization of these possibilities is the hesitancy of capitalists to invest in hydroelectric developments, and the difficulty in getting permits for the utilization of these natural resources, upon which the industrial prosperity of the West is so dependent. Investors fear to tie up their money in such pioneer projects as are now subject to prohibitive legislative restrictions. Oil lands and phosphate deposits have been withdrawn from entry, "conserved" kelp is rotting on our shores and "conserved" water power is running idly to the sea.

This wicked waste shackles the West. Think of the farmer dependent upon Norwegian nitrates, the miner upon Swedish iron and everyone upon Eastern manufactured products when the requisite power and materials await only the application of human intelligence. What the West needs is not merely an electrochemical atmosphere, but an electrostatic thunder storm to awaken it to the value of its birthright—surrendered for a mess of pottage.

PERSONALS

Leonard Cairns, assistant manager of the street railway and lighting company at Manila, is at San Francisco.

E. M. Cutting, Pacific Coast manager Edison Storage Battery Company, is in Southern California.

Geo. Bower has been appointed assistant sales manager of the Northwestern Electric Company, Portland, Oregon.

H. H. Courtright, otherwise known as "Kelley," is now manager of the Valley Electrical Supply Company at Fresno, Cal.

Geo. J. Henry, hydraulic mechanical engineer of San Francisco, just returned from an extended business trip to Alaska.

S. E. Ross, commercial agent of the Truckee River General Electric Company, of Reno, spent the first part of the week at San Francisco.

H. A. Lemmon, contracting agent of the Truckee River General Electric Company, of Reno, was a recent business visitor at San Francisco.

C. R. Hunt, Pacific Coast representative of the Robbins & Myers Company, has returned from an extended trip of about a month throughout Arizona and the southern part of California.

J. B. Lukes, formerly manager of the San Francisco office of the Stone & Webster Construction Company, has recently been transferred to the company's main office in New York.

Chas. A. Terry, vice-president of the Westinghouse Electric & Manufacturing Company of New York, N. Y., in company with wife and daughter, are recent arrivals on the Pacific Coast.

Harry L. Strange has been granted leave of absence as manager of the Honolulu Gas Company to enlist with the allies. **Frank Cannon**, manager of the commercial department, has been appointed acting manager.

W. H. P. Hill will leave shortly for California to assume a new position with the Fleishhacker interests. Mr. Hill has been with the Northwestern Electric Company in Portland for the past year as commercial manager.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, is in the East attending a meeting of the public policy committee of the National Electric Light Association.

Ewen Cameron has relinquished his connection as secretary-manager of the Electric Agencies Company, at San Francisco, and has been succeeded by **B. A. Wagner**, formerly manager of the Los Angeles office of the company.

N. Kishi, superintendent mechanical engineer of the Osaka Electric Light Company of Osaka, Japan, is a recent arrival at San Francisco, from where he expects to start on a tour of inspection of the power plants of the United States.

R. H. Ballard, secretary and assistant general manager of the Southern California Edison Company and vice-president of the National Electric Light Association, is expected to return to Los Angeles on March 4th from a meeting of the executive committee of the association.

J. R. Wilson has resigned as sales manager and second vice-president of the Crocker-Wheeler Company, Ampere, N. J., to take up activities in other fields. Mr. Wilson has been associated with the Crocker-Wheeler Company for sixteen years, being placed in charge of sales operations in 1910.

MEETING NOTICES.

Electrical Supply Jobbers' Associations.

The next convention and annual meeting of the Electrical Supply Jobbers' Association of the Pacific Coast will be held at Del Monte, March 2, 3, 4, 1916, the first session being held on Thursday afternoon, March 2d, at 2:30 p. m.

San Francisco A. I. E. E. Section.

A meeting will be held at 8 p. m. February 25th at Engineers' Club, 61 Post street. S. J. Lisberger will speak on some features in connection with the installation of two submarine power cables across the Golden Gate.

Electrical Development and Jovian League.

At the weekly luncheon on February 16th, H. V. Carter, President of the Pacific States Electric Company, introduced Dr. Beason who gave a first-hand account of his experiences as a Red Cross surgeon in Serbia. His vivid account visualized the horrors of war in this stricken country.

Portland Sections A. I. E. E. and N. E. L. A.

At the bi-weekly lunch on February 17th, W. H. P. Hill, commercial manager Northwestern Electric Company, acted as chairman of the day, first reading two telegrams of congratulations sent to Thomas Edison on his birthday. Col. C. E. S. Wood spoke on "Preparedness," discouraging too much fighting in a "trade" war, urging that disputes be settled by arguments rather than wars. Eighty-five members were in attendance.

Inland Waterways Association of California.

The annual meeting of the Inland Waterways Association of California and a special congress under the auspices of the association, was held at the Palace Hotel, San Francisco, February 21-22, 1916. The general topic for discussion was "What Reorganization of Federal and State Agencies is Needed to Promote Economy and Efficiency in Working for the Conservation, Control and Utilization of Waters?" Papers were read Monday on "Uses of Streams," by Prof. Stephen Ivan Miller, Jr., Stanford University; "Governmental Agencies Dealing with Various Phases of Our Water Problems," Federal Agencies, J. B. Lippincott, Los Angeles; State Agencies, D. L. Beard, San Francisco; "The Department Plan in Public Work," C. E. Grunsky, San Francisco, and a general discussion, with a view to Determining to what Extent Economy and Efficiency may be Promoted by Consolidating or Co-ordinating the Work of Present State Boards, Commissions and Bureaus Dealing with Water Problems.

Idaho Society of Engineers.

The seventh annual convention of the Idaho Society of Engineers was held at Burley, Idaho, February 21-23, 1916, President Barry Dibble presiding. Reports were received from the committees on irrigation and papers presented on "The Irrigation and Code Commission," by V. E. Anderson; "The Camera and the Engineer," by F. A. Wilkie; "The Use of Concrete," by W. F. Long; "Phosphate Deposits in Southern Idaho," by Robert N. Bell; "Manufacture of Beet Sugar," by J. F. Ellis; "Irrigation Pumping and Power Rates Therefor," by W. T. Wallace; "Hydrometric Data and Practice on the Minidoka Project," by J. S. Longwell; "Siltling of Canals and the Minidoka Drainage System," by F. N. Cronholm; "Surveys of Overflowed Lands in Arkansas," by A. N. Kim-mell. A banquet was held on the evening of February 22nd, G. Clyde Baldwin being the toastmaster, the following responses being made: "George Washington," by J. J. Rae; "The Engineer's Opportunity to Serve His Country," by Barry Dibble; "The Success of Irrigation Projects," by E. B. Darlington; "Just for Fun," by J. C. Porterfield; "When Times Come Good in Idaho," by W. H. Gibson; "Au Reservoir," by C. H. Mull.

JOVIAN REJUVENATION AT LOS ANGELES.

A remarkably well-organized and highly successful rejuvenation of the Jovian Order was held in the Elks' Club at Los Angeles on February 19th. Tribune Henry F. Holland, early in the year, had appointed two teams, the reds and the blues, who worked up a class of thirty-nine men for initiation into the mysteries of Jovianism. The competition thus engendered was maintained at the fine banquet which preceded the rejuvenation by the appointment of two toastmasters, A. E. Morphy heading the blues and B. B. McLean the reds. It is no more than fair to state that while the blues were not as active as the reds in getting new members, they provided more pep in the way of speakers. Their representatives seemed to be talkers, rather than doers.

As chairman of the entertainment committee Harry Sessions had provided an excellent program which started the party off in fine shape. This was greatly enjoyed.

Toastmaster McLean introduced Statesman J. N. Colkitt, Paul House and Harry Sessions, as speakers for the offense, while Toastmaster Morphy produced J. E. McDonald, Past Vulcan A. H. Halloran, and E. M. Cutting for the defense.

Upon adjournment to the lodge room the ritual was unusually well presented by the degree team, as follows:

Jupiter, J. Harry Pieper.	Avrenim, C. E. Cayot.
Neptune, W. J. Gracey.	Mercury, J. O. Case.
Mars, A. L. Spring.	Imps:
Vulcan, H. F. Holland.	E. B. Clay.
Apollo, R. R. Thomas.	R. C. Starr.
Hercules, L. E. Darrow.	W. J. Barman.
Pluto, Z. H. Sherart.	H. C. McCutchan.

Including the candidates, 175 electrical men were present. The following candidates were completely rejuvenated:

H. P. Hubbard, Forue-Pettebone Co.
 R. L. Smith, Pacific Light & Power Corp.
 H. H. Miller, Pacific Light & Power Corp.
 L. K. Thompson, Pacific Light & Power Corp.
 P. D. House, Electrical Products Corp.
 Edgar Ruggles, Pacific Light & Power Corp.
 B. A. Griswold, Jr., Pacific Light & Power Corp.
 N. H. Cox, Manufacturers' Agent, Santa Ana, Cal.
 Richard Walfsberg, Electric Agencies Co.
 A. B. Nauert, United States Steel Products Corp.
 F. R. Palmer, Pacific Light & Power Corp.
 W. C. McWhinney, Pacific Light & Power Co.
 R. C. Shipman, Pacific Light & Power Corp.
 W. D. Shaw, Pacific Light & Power Corp.
 Schuyler Coffin, Pacific Light & Power Corp.
 Frank Palmer, Pacific Light & Power Corp.
 C. C. Stillman, Pacific Light & Power Corp.
 E. P. Miller, Pacific Light & Power Corp.
 W. E. Hogle, Pacific Light & Power Corp.
 E. F. Vittum, Pacific Light & Power Corp.
 S. W. Clement, self, Inglewood, Cal.
 Frank Weiss, Los Angeles, Gas & Electric Corp.
 A. S. Price, Pacific Light & Power Corp.
 C. E. Listenwaller, Listenwaller & Gough, Inc.
 A. E. Rimpan, Edison Lamp Works of General Electric Co.
 Theo. Palmer, Palmer Motor Shop, Santa Ana.
 P. S. Gough, Listenwaller & Gough Co., Inc.
 C. R. Atkinson, Pacific Light & Power Corp.
 Philip Forue, Forue-Pettebone Co.
 C. H. Deaves, Western Auto Electric Corp.
 A. E. Peat, San Joaquin Light & Power Corp.
 C. S. Older, Pacific Light & Power Co.
 J. S. Addis, Illinois Electric Co.
 A. G. Hall, Illinois Electric Co.
 H. A. Landwehr, American Cement Products Co.
 H. A. Koll, A. Hamburger & Sons.
 A. E. Ravenscroft, Baker-Joslyn Co.
 T. A. Gould, Redondo Home Tel. Co., Redondo Beach, Cal.
 E. L. Nightingale, General Electric Co.

NEWS OF CALIFORNIA PUBLIC SERVICE COMMISSION.

Constructive criticism of the methods used by the commission's engineers in calculating depreciation of public utilities may be invited at a series of public sessions. The straight line basis of accrued depreciation apparently works a hardship on the stockholders, and the necessity has arisen for a general discussion on the subject.

The Pacific Light & Power Corporation has filed a complaint against the City of Pasadena, requesting the commission to direct Pasadena to obtain a certificate as a public utility to furnish electricity for light and power in South Pasadena, which is separately incorporated, and to file a schedule of rates to be collected from consumers in South

Pasadena. The Pacific Company also sells electricity in South Pasadena, and the company asserts that the City of Pasadena is engaged in active competition with it, and has taken away many of its customers. It claims to be losing more than \$3500 a year by this competition.

NEWS OF IDAHO PUBLIC SERVICE COMMISSION.

The commission has denied the application of J. A. Jones for a certificate of public convenience and necessity to construct a gas plant at Idaho Falls, Idaho, and has granted one to Wm. D. Wilcox upon condition that he commence construction not later than June 1, 1916, and have plant ready for operation by October 1, 1917.

TRADE NOTES.

The Portland council has awarded a contract for furnishing 8000 ft. of electric light cable for the proposed lighting system in Holladay Park to the Standard Underground Cable Company.

The Electric Storage Battery Company recently gave a course of instruction on storage battery design and operation to officers and men of the U. S. submarine flotilla. The Navy Department has expressed its gratification for the service.

School Clerk R. H. Thomas will receive proposals until 4 p. m. Thursday, March 2, for a program clock system for the Franklin high school, Portland, Ore. Specifications from office of School Architect F. A. Naramore on deposit of \$1.

A contract for heating and ventilating Wheeler hall at the University of California, Berkeley, has been awarded to The Turner Company, San Francisco, for \$51,880. The contract for electric wiring has been awarded to NePage-McKenny Company, Hearst building, San Francisco, for \$6089.

The A. Lietz Company, manufacturers of surveying, engineering, mining and nautical instruments, have opened up fine display and sales offices at 61 Post street, San Francisco. As this is on the ground floor in the Mechanics' Institute Building, wherein the Engineers' Club is now housed, the location is most convenient.

CONSTRUCTION STARTED ON WISE AND HALSEY PLANTS.

The Pacific Gas & Electric Company expects to have Nos. 4 and 5 of its Lake Spaulding development, known as the Halsey and Wise plants, completed and in operation by November 1, 1916. Both these plants will utilize the discharge from the Drum plant, being carried in the Bear Valley Canal from a point just above Colfax. The Halsey Development will have a forebay, or regulating reservoir, built in the saddle of the ridge by means of two earth dams. Two pressure tunnels are designed in the alignment of the development to carry the flow of water to the power house, one of which leads directly from the forebay. These tunnels will be concrete lined, connected with a wood stave pine 96 inches in diameter and terminating with a 72-inch steel pipe line at the power house. The steel work on the power house has just been completed. The electric generator to be installed in the power house, located about three miles west of Clipper Gap, will be driven by two overhung Francis type turbines, operating as a unit to develop 18,000 horsepower under a 342 ft. maximum head of water.

The Wise Development takes the water almost at the floor of the Halsey plant from a small regulating reservoir of 120 acre ft. capacity through canals, tunnels, forebays and penstocks to the power plant in Auburn Ravine, about a mile below the city of Auburn. The generator at this power house will be similar to the one installed at the Halsey plant, having a capacity of 16,600 horsepower, and will be driven by a 20,000 horsepower Francis turbine.



NEWS NOTES



INCORPORATIONS.

ZILLAH, WASH.—Articles of incorporation of the Valley Telephone Company, with \$50,000 capital stock, have been filed by L. E. Harrington, E. F. Keys, H. M. Manuel, R. W. Manuel and A. M. Murfin.

ILLUMINATION.

RIVERBANK, CAL.—L. H. Collett has a petition ready to present to the Supervisors for the formation of a lighting district for west Riverbank.

LOVINGTON, N. M.—This place will be electric lighted within a few weeks, final arrangements for lighting having been made by T. H. Beckwith.

STARBUCK, WASH.—The dam of the Starbuck Electric Company was seriously damaged by a recent storm, leaving the town without lights.

ABERDEEN, IDAHO.—The city is to have electric lights, a 50 year franchise having been granted to the Idaho Water Power Company for the installation of the system.

EPHRATA, WASH.—C. A. Logg of Bright has leased the Lee Toliver garage and has announced his intention to equip the electric light plant to furnish electricity to all who desire it.

FLORENCE, ARIZ.—An election will be held on March 11th to vote on the question of issuing bonds in the sum of \$50,000 for the purpose of constructing a system of water-works and electric lighting.

SALT LAKE, UTAH.—Extensions and betterments to the plant and mains of the Utah Gas Company to cost about \$125,000 have been announced by Byron T. Gifford, chief engineer of the American Public Utilities.

SAN BERNARDINO, CAL.—At a meeting of the street lighting committee, action giving bid for lighting E and Fourth streets to J. J. Hanford was rescinded and the contract was awarded to E. J. Field for \$1 a front foot.

EL CENTRO, CAL.—W. F. Holt has announced that he has sold a \$25,000 interest in the Imperial Valley Gas Company to J. M. Ott of Rochester, Ind. Mr. Ott will be elected president and the main office will be moved here from Redlands.

SPOKANE, WASH.—Riverside avenue will be lighted from Division street to Cedar street if plans launched by property owners materialize. A petition has been put in circulation asking for the completion of the lighting of the avenue.

HOLBROOK, ARIZ.—The board of supervisors of Navajo county will hold a hearing on March 6th on the application of Jas. J. Shumway for a franchise for the construction and operation of an electric light and power plant in Snowflake to supply the towns of Snowflake, Taylor and Shumway.

LOS ANGELES, CAL.—The board of public-service commissioners has let the contract for 4000 cedar poles to be used in connection with the installation of a municipal lighting system to Baxter & Jordan. M. S. Bulkley has been awarded the contract for four auto trucks to be used for hauling on the lighting system's work.

BAKER, ORE.—Superintendent Ross of the municipal electric light plant, has announced that the greatest difficulty with the water wheel at the electric plant had been remedied and that with the full flow of water, practically the entire estimated power could be developed. To date the plant has developed hardly more than 50 per cent of the estimated power. With this report the commissioners announced that plans would be made at once for installing cluster lights in the business district of the city and that

until this could be accomplished additional street lights will be installed temporarily.

TRANSMISSION.

PORTERVILLE, CAL.—A new \$40,000 substation is to be erected here by the Mt. Whitney Power & Electric Company.

BAKERSFIELD, CAL.—The board of supervisors has awarded the Pacific Light & Power Co. a franchise for the purpose of supplying the Kernville District.

LOS ANGELES, CAL.—A resolution has been adopted by the city council authorizing the city attorney to file a condemnation suit for the purpose of acquiring a right-of-way for constructing and operating electric power lines extending from a point in the county of Inyo through lands in the Providencia and Scott Tract, McOlay Ranch, and a portion of the Porter Land and Water Company, all lying in the San Fernando Valley.

TELEPHONE AND TELEGRAPH.

ANBURN, CAL.—Farmers of the Mt. Vernon and Edgewood districts have decided to install a new telephone line from Auburn to a point about two miles beyond Mr. Vernon.

MARYSVILLE, CAL.—The residents of the Oregon House, Dry Creek and Dobbins section of Yuba county will be served by a new farmers' telephone line, which will be built shortly.

MAGDALENA, N. M.—The Forest Service has definitely arranged to establish a wireless station at this place, and a similar station at Aragon, N. M. The sending capacity of these stations will not be less than 100 miles.

DENVER, COLO.—At the annual meeting of the Mountain States Telephone & Telegraph Company \$3,950,000 was voted for extension and betterments of the system to be carried out this year. The meeting was held at the general offices here. The annual report showed the net income of the company for the year 1915 at \$2,316,175.

TRANSPORTATION.

CALDWELL, IDAHO.—Electrification of the Oregon Short Line branch from Caldwell to Wilder, a distance of 12 miles, is to be financed by the business men of Caldwell and farmers along the line through a bond issue of \$25,000. Subscriptions for bonds exceeded the amount asked for. The branch has been leased by the Caldwell Traction Company, and will be operated in connection with the company's present system. Officials of the company declare that the line will be in operation within 30 days after the arrival of material necessary for the electrification.

LOS ANGELES, CAL.—Preliminary work has started on the Pacific Electric elevated track scheme which, when it is completed, is expected to reduce railway congestion on Main street by 50 per cent. The two main line tracks, which run through the building from Main street onto the elevated structure, now used will not be disturbed. This elevated track will be extended to San Pedro street. On its north side an additional viaduct will be constructed, which will hold five tracks side by side. The elevated will narrow east of Maple avenue and the five tracks will be reduced to two. The elevated will take care of the north, east and south traffic of the Pacific Electric, including Pasadena, Monrovia, Azusa, San Bernardino, Santa Ana, Long Beach and San Pedro. The main tracks, which run into the building from Main street, will handle the Glendale and some other traffic.

WATERWORKS.

TWIN FALLS, IDAHO.—At the recent election the people of Twin Falls voted in favor of the \$80,000 bond issue for taking over the present water system.

SEATTLE, WASH.—A permit has been granted by the county commissioners to the Lake Forest Light, Water & Power Company to lay water pipes in the Lake Forest Park Addition.

EL CENTRO, CAL.—The city trustees and business men are seriously considering submitting at the spring election a bond issue to install a filtration system for water here, at an estimated cost of \$35,000.

POCATELLO, IDAHO.—The village of McCammon has sold to James N. Wright & Co. of Denver the \$22,000 worth of water bonds of that town, and the construction of the water system will begin at once.

HOOD RIVER, OREGON.—At the annual meeting of the Farmers' Irrigating Company the board of directors were instructed to appoint a committee with authority to proceed to finance the development of the power site at their intake on Hood River.

CANBY, ORE.—Canby is considering a municipally owned water system, to be acquired either by purchase of the present M. J. Lee plant or by building a new system. Members of the council are in favor of issuing bonds and building a new system, at the cost of \$15,000.

ROSEBURG, ORE.—The Yoncalla city council has passed an ordinance calling for a special city election, to be held April 17th, for the purpose of voting bonds in the sum of \$20,000 for the construction of a city water system. The survey for the system has already been made.

ANAHEIM, CAL.—At a meeting of the directors of the Anaheim Union Water Company the superintendent and engineer were appointed a committee, with power to act, to secure a site and install a pumping plant in the river where the water can be furnished to stockholders until repairs on the ditches are completed.

OATMAN, ARIZ.—It is reported that a movement is under way to provide Oatman and neighboring towns and mines with a one and a half million gallon capacity waterworks. Plans provide for a reservoir, the supply to be drawn from wells near the Colorado River. Pumps will force the water through a 10 in. pipe 12 miles.

PORTLAND, ORE.—Bids will be received by the City Auditor until March 9th for the purchase of \$125,000 worth of water bonds of the City of Portland, in denominations of \$1000 each, payable 25 years from date and bearing 4 per cent interest. The sale is for the purpose of raising funds for the construction of water mains, laterals and for the purchase of meters.

RICHMOND, CAL.—Representatives of the Snow Mountain Water & Power Company appeared last week before the Richmond Water Commission and presented their proposition for a water supply for the city. The \$6,000,000 required to handle the supply was too large for the district and the proposition was not seriously considered. The report of Engineer J. H. Dockwieler will be ready for the board about the first of April.

SANTA MONICA, CAL.—Petitions are being circulated for another bond election for the purchasing of four water companies. The attempt made some time ago failed by a small margin. The movement is being promoted by the Municipal Ownership League, which also favors securing Owens River water, either with or without annexation. The water companies have refused to reduce their figures stated in the last election at \$750,000.

SAN DIEGO, CAL.—The city council has voted to divert immediately \$75,000 of bond money to the construction of a pipe line from Upper to Lower Otay. The line will cost about

\$30,000, and the remainder of the fund will go toward the construction of a pipe line from Dulzura Creek to Upper Otay. Voters will be asked at an election to consent to the diversion of approximately \$114,000 remaining in San Diego River development bond fund to build a pipe line from Dulzura Creek to Upper Otay and repair the conduit from Morona reservoir to the head of Dulzura Creek.

CALIFORNIA STATE WATER COMMISSION.
APPLICATIONS.

The Cheney Slough Irrigation Company of Colusa has applied for permission to appropriate 200 second feet of water from the Sacramento River within the borders of the old Jimeno Rancho. A pumping plant of three or four separate units is proposed to lift the water from the river, pumping into a main canal 10 miles in length, from which the water is distributed over approximately 10,000 acres. The estimated cost of the plant is \$50,000.

The Atascadero Mutual Water Company of Atascadero, San Luis Obispo County, has applied to appropriate 30 second feet from the Salinas River for irrigation and municipal purposes. The plans call for three pumping plants, each capable of seven million gallons a day, pumpage to be direct from wells in the bed of the river into the mains. There is a contemplated storage reservoir to hold 60,000 acre feet, with dams of rock fill construction to impound the water. In addition to furnishing a municipal supply, it is intended to irrigate some 23,000 acres of land. The estimated cost of the plant is fixed at \$750,000.

Robert L. Hargrove, J. G. Roberts and E. M. McCardle, as trustees for the proposed Madera Irrigation District, have filed an application asking for the appropriation of 5000 second feet of the waters of the San Joaquin River, Fresno and Chowchilla Rivers, Cottonwood, Sand, Hildreth, Dry and Mariposa Creeks, for the purposes of irrigation of some 400,000 acres of land. There is contemplated a dam 230 feet high, of concrete, with ten storage reservoirs, with a capacity of 380,000 acre feet, and a main ditch 45 miles in length. The estimated cost to put the water on the land is given at the extremely low figure of \$10 per acre.

The James Mills Orchards Company and the Esperanza Land Corporation of New York, with California headquarters at Hamilton, Colusa County, has applied for permission to appropriate 20 second feet of the waters of Stone Corral Creek, Colusa County, tributary to Colusa Basin, for agricultural purposes. The companies intend to install pumping plants for the irrigation of about 5000 acres.

T. M. O'Keefe of Palo Cedro has applied for permission to appropriate 25 second feet of the waters of the main Cow Creek, in Shasta County. The intention is to divert the water by means of a timber and rock dam into a canal 6½ miles long and carry same to 1444 acres. The estimated cost is \$10,000.

The La Mesa, Lemon Grove and Spring Valley Irrigation District of La Mesa, San Diego County, has applied for permission to appropriate 100,000 miner's inches of the waters of San Diego River in that county, flood waters, and 5000 inches of the natural flow for purposes of irrigation and municipal use. There is proposed for the system a storage dam 103 feet high, a storage reservoir with a capacity of 34,000 acre feet, and a pipe line 2½ miles long. It is intended to irrigate approximately 15,000 acres, the plant to have an estimated cost of \$1,232,500.

The Oak Creek Land & Water Company of San Francisco has applied for permission to appropriate 70 second feet of the waters of Oak Creek, near Mojave, in Kern County. There is proposed a dam 120 feet high, a storage reservoir capable of holding 50,000 acre feet, a main ditch 7½ miles long to water 61,440 acres, at an estimated cost of \$600,000.

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Fobes Supply Co., Portland and Seattle. | W-5 Westinghouse Machine Co.....
141 Second St., San Francisco. |
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Devoted to the Conversion, Transmission and Distribution of Energy

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DIESEL ENGINE APPLIED TO MARINE PURPOSES.
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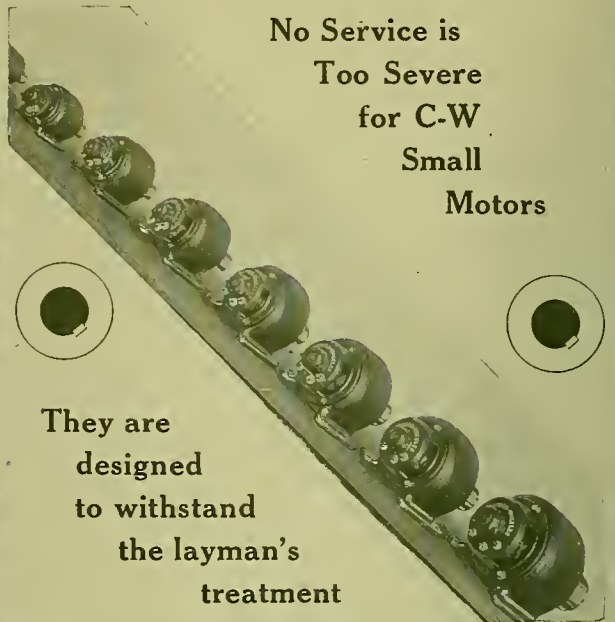
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COMMERCIAL SUCCESS OF RITTMAN PROCESS

The Rittman process for the manufacture of gasoline, benzine and tuolene from crude oil has been proven a success on a commercially operative scale and a number of plants are being erected to supply the increasing demand for gasoline in automobiles and tuolene in the manufacture of explosives. The patents on both processes are to be dedicated to the public, and permits for their use may be obtained from the Secretary of the Interior. The full procedure for such

deg. to 675 deg. C. and at a pressure up to 250 pounds. The processes are to be distinguished from the ordinary cracking processes in that the hydrocarbon material is kept in a gaseous state throughout the entire course of operation.

Large yields of gasoline hydrocarbons from all petroleum from the lightest distillates to the heaviest residuum, including heavy crude oils of an asphaltic nature, such as crude Mexican and California oils.



Laboratory at Development Plant, showing Type of Distillation Apparatus and Electric Furnaces Used in Testing Cracked Oil.

application, as well as an account of all experiments, is given in Bulletin 114, from the U. S. Bureau of Mines.

The general method of operation in both processes is a repeated cracking of the oils. The conditions of control, however, differ materially, and the end products vary widely. The gasoline process is operated at lower temperatures and high pressures; for example, at a temperature of 500 deg. to 550 deg. C., and at a pressure up to 300 pounds, whereas the benzene-toluene process is operated at a temperature of 625

On February 1, 1916, seven refineries, in six states, were installing plants for the gasoline process. The production from a given quantity of original oil is not limited to the first run, but the residuum above the gasoline fraction can be rerun through the furnace and a like proportion of cracked gasoline obtained. The process may be repeated until the oil has been completely converted. In this manner 80 to 90 per cent of the original oil can be converted into gasoline. The favorable conditions for gasoline formation seem to be moderate temperatures and high pressures. In

commercial work, a temperature ranging between 500 deg. and 550 deg. C. and a pressure of 12 atmospheres and upward will be found suitable, as high a pressure as can be maintained within the limits of safety being desirable, because of the improved quality of the gasoline.

The so-called aromatic hydrocarbons can likewise be obtained in commercial quantities from all types of petroleum oils. The favorable conditions seem to be high temperatures and moderate pressures. In commercial work a temperature ranging between 625 deg. and 700 deg. C. and a pressure of upward of 8 atmospheres will generally be most suitable.

The war in Europe has created an enormous demand for benzene and toluene as raw materials for



Carbon Pots Used in Practical Treatment.

the manufacture of explosives. Toluene, which normally sells for less than 25 cents a gallon, can not be bought in quantity at present (November, 1915), at \$5 a gallon.

Trinitrotoluene, which is obtained by treating these compounds with nitric acid, has taken first rank among the explosives used for bursting charges because of its low melting point, its safety in handling, its nonacidity, which eliminates corrosion of metallic surfaces in contact with it, and the ease with which the time of its explosion may be controlled.

The processes have been carefully studied with reference to their adaptability for treatment of California crude oils with an asphaltum base. Either is feasible and desirable. One of the greatest difficulties experienced in practice is accurate heat control. Most of the furnaces are gas-fired and do not lend themselves as readily to temperature regulation as do the electric furnaces employed in the laboratory experiments. This suggests the possibility of utilizing electric heat in the industrial treatment of the oils.

In many respects the Rittman process is one of the most useful inventions of the past decade. It opens up great possibilities for industrial development, not only in the supply of gasoline for automobiles and other uses, and of toluene for explosives, but also of raw materials for the manufacture of aniline dyes.

DEPRECIATION AS AN ELEMENT IN RATE MAKING.

BY JARED HOW.

(This argument against the consideration of accrued theoretical depreciation in the cost to reproduce a utility is taken from a brief presented by the author before the California Railroad Commission in a rate case of the Northern California Power Company.—The Editor.)

All expenses incurred by the owner of a public service property, whether for operation of the property or maintenance of it, stand upon the same footing. They are all incurred in the performance of its obligations to the public arising under its franchise, of which the obligation to operate the property is no more nor less firm than the obligation to keep it in adequate condition for operation. And all such expenses are incurred because of the consumption, by the owner of the property, of some thing or other in producing the service to the public. It may take twenty minutes to consume a barrel of oil, used for fuel, and it may take twenty years to consume a steel rail in a railroad track. But whatever the period of time required for the consumption, and whatever the method through which the consumption progresses, the result is the same; and whatever is consumed must be replaced by the owner of the property by virtue of its obligation to the public—the steel rail to the end that the property may be maintained in adequate condition for operation; and the barrel of oil to the end that, when so maintained, the property may be continuously operated; and each of them and both of them to the end that the public may be assured of the sufficient and continuous service contemplated by the grant of the franchise under which it is rendered.

But barrels of oil are consumed rapidly and must be constantly replaced; while steel rails, and other things used by public servitors, such as pipes, machinery and so forth, are consumed slowly and are required to be replaced only at long intervals. If they could be replaced proportionately, from month to month, or from year to year, the expense of replacement in each month or in each year would be comparatively trifling; and, if collected as needed, would not be a serious burden upon the public which has to endure it. If, on the other hand, the collection by the owner of the property from the public of the amount necessary for replacement of articles which require replacement only at long intervals should be deferred until the year in which replacement should become necessary, the result would be such a great inequality in rates as would impose a serious burden upon the public. Therefore, in order that rates may be equable from year to year, it has become recognized as proper practice to permit the amount necessary for making such replacements to be collected by the public servitor from the public (if it can be done through rates which shall not be unreasonably high) in the same manner as if the replacements could and should be made proportionately from month to month, or from year to year, and to preserve the amounts so collected in what is commonly called a depreciation fund to respond for the expenses of replacement when it shall become necessary to incur them.

The amounts necessary for a proper depreciation

fund are measured by what is sometimes called accrued theoretical depreciation—that is to say, theoretical depreciation estimated for the period which the fund is designed to cover, and based on the diminution in the length of the original period of serviceability of the various items to which it is applied.

It is perfectly obvious that the so-called theoretical depreciation is not depreciation at all; and that it is merely progress toward the necessity for expenditures for maintenance. It has nothing to do with deterioration of the composite plant, considered as one entire instrument for the performance of the obligation to render the service to the public which its owner has assumed.

It is equally plain that the so-called depreciation fund is not a depreciation fund at all; and that it is merely a maintenance fund—a fund accumulated for use in the future to provide for the expense of the owner of the property, which must be incurred, in performing its obligation to maintain the property, at all times, in condition such that it will sufficiently render the service for which it was installed. So long as that obligation is performed, the property employed in the service never deteriorates in efficiency and, therefore, never depreciates in value for the only use by which its value may be estimated, because the only use to which it may ever be put—the service to the public for which it was enlisted under the franchise which covers it. And it seems to follow decisively that, so long as that obligation is performed, the value of the use of the property, as between its owner and the public which it serves, never can depreciate.

It is perfectly clear, further, that, inasmuch as this so-called depreciation fund has been collected from the public by the public servitor for the purpose of providing it with money to meet the expense of replacements when, from time to time, they shall become necessary for the maintenance of the property, the fund can be used only for that purpose. (*Louisiana Railroad Com. vs. Cumberland Tel. Co.*, 212 U. S., at pages 424-5.) It is a quasi trust fund for the performance of the obligation of the public servitor to the public to keep the property devoted to the use of the public always in a condition of complete efficiency. If it were in fact a depreciation fund, instead of a maintenance fund, its function, of course, would be to compensate the owner of the property for the loss which it has sustained in the depreciation of the value of its property necessarily involved in rendering the service to the public—to amortize the investment so far as that depreciation in value has progressed. If that were its function, the amount in the fund would, as collected, be distributable to the stockholders of the owner of the property to indemnify them for loss in their investment. The fact—and no body will contend that it is not a fact—that the so-called depreciation fund may not properly be so distributed, but that it must be used, and used only, for replacement of such portions of the property as shall have been consumed in the service, is a complete demonstration to the conclusion that the fund is not a depreciation fund at all and that it is merely a fund provided for the payment of the expenses of operating the property.

The proposition that the obligation of the owner of the property grows toward maturity in precisely

equal proportion with the progress toward destruction of the respective parts of the property to which the obligation attaches, seems to be mathematically exact; and, if accrued depreciation, at any time, of any such integral part can properly be said to exist and to be measured by the proportionate amount at that time of its progress toward destruction, it seems to follow, with mathematical exactness, that the accrued obligation of the owner to replace such integral part, when it shall have reached the end of its progress toward destruction, must also exist at the same time and must be measured by the same standard. If, then, the amount of "accrued depreciation" and the amount of "depreciated reproduction cost" of any privately owned public service property, make, together, the amount of the "cost to reproduce" the property, the conclusion is not to be avoided that the amount of accrued obligation to replace of the owner of the property and the depreciated reproduction cost of the property make together the cost to reproduce the property.

The fair value of the property at the time of its use must mean its fair value in the service rendered by its owner and not the fair value for the purpose of taking it out of that service; and, in view of what has been said with regard to the franchise obligation which attends privately owned public service property, it must mean the fair value of the property with the franchise obligation which covers it, and not its fair value stripped of that obligation. It must mean, therefore, the fair value of the property with its attribute of eternal life, and not its fair value without that attribute, but subject to the ordinary tendency to destruction.

Theoretical depreciation is based, not upon actual deterioration of the property to which it is applied, but upon its liability to deteriorate; and it is measured by the progress toward the end of serviceability of integral parts of the composite property, avowedly upon the theory that, when the end of that serviceability is reached, the value of the composite property will, on that account, be lessened. But, as has been demonstrated, that theory is utterly unsupportable; because, through intervention of the franchise obligation of its owner to maintain the property at all times in a condition of entire adequacy, the integral parts of the composite property which are subject to destruction must be replaced before they reach the end of their serviceability, and before their lack of serviceability may impair the value of the composite property. Considered merely as integral parts of the composite property—and that is their only function—they may never perish. They must always live—and live with full vigor. Theoretical depreciation, therefore, is based upon a tendency to destruction, and is measured by a growth toward destruction, neither of which has any existence.

The conclusion is not to be escaped, then, that lessening the fair value of privately owned public service properties by the amount of accrued theoretical depreciation, for the determination of the "basis of calculation" of the just compensation to the owner for the service rendered to the public, results in confiscation from the owner of just that amount of "the value of that which it employs for the public convenience." *Minnesota Rate Case*, 230 U. S. at page 435.

KEEPING ELECTRIC WATER HEATING "OFF THE PEAK."

BY T. W. SIMPSON.

(In view of the increasing importance of the electric range load to Western central stations this simple suggestion for the control of electric water heating should be of interest to central station operators. The author is manager of the Federal Sign System (Electric) at San Francisco.—The Editor.)

To justify low rates for electric water heating, many systems should keep this load off the peak insofar as possible. The problem is occupying the attention of some of the ablest utility operators at this time, and the following notes may not be amiss.

Which Peak to Keep Away From.

The capital investment for a wide extension of electric cooking and water heating is first noticed in the local distribution network, leading to the purchase of additional transformer and low voltage line capacity. These lines are those that supply households and they are loaded up to their peak in the evening lighting period regardless of whether or not the system or generating station peak is in this lighting period. The diversity factor on large generating systems may cause a day-time system peak or an "early evening peak" characteristic of large cities, but these system peaks are not coincident with the lighting peaks of the local distributing centers.

It is difficult to connect system peaks of this nature with the water heater problem except by academic reasoning, since a practical examination of many systems will show that the superposition of any reasonable amount of water heating load on such peaks will have no effect on the available generating station or transmission line capacity. The truth of this assertion will be evident when one considers that the generating and transmission system will, from the nature of things, be adjusted to the early evening electric range load which is developed along with the water heater load, so that the effect of the water heater load itself on any part of the system outside of the local distribution is nil. This assumes of course that a two-way switch keeps the water heater off when the range is on.

Therefore one concludes that water heaters must be kept off the peak of the local distribution system to insure important savings in capital investment, regardless of whether they are kept off the system peak when it does not coincide with the local distribution peak.

Practical Requirements of the Device.

The device for such a purpose need not possess a high order of technical excellence, since its use is of a corrective nature only, and if successful in keeping 80 or 90 per cent of the water heaters off of the peak, it will serve all practical engineering purposes of the case. Emphasis should rather be placed on the low cost, stability, simplicity, and fool-proof qualities of the device rather than on technical excellence or the ability to adjust the switch to conform to seasonal changes of the peak or to furnish it with automatic features.

There have been developed time switches for this purpose embodying an eight-day clock throwing the heater on and off once each day and omitting the

period prescribed as the peak. A relay device opens the circuit at the end of the sixth day, requiring the clock to be rewound and reset before it can be closed. This device is not fool-proof because if the clock stops at say 11 p. m. and its stopping is not discovered until next morning, it would be reset to 11 a. m., but the on and off mechanism would then possess a 12 hour lag unless the householder knew enough to handle the switch setting.

Another device is based upon the principle of choosing the branch-off from the residence cut-out box to the parlor cluster as the "key" to the peak. One side of this circuit is conducted over a thermostat couple so that when this circuit is energized, the thermostat closes a relay circuit carrying but 1/20 am-

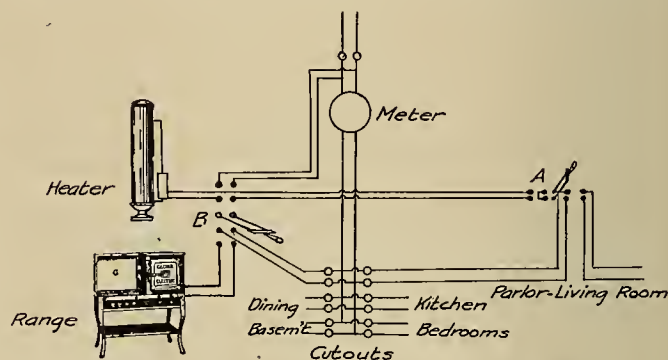


Diagram of Connection for Electric Water Heater.

pere, but this relay opens the main water heater circuit. The reverse occurs when the current of the parlor cluster circuit is off.

This device is related to the first solution of the off peak water heater problem which was to have a simple throw over switch so that when the house lighting was "on" the water heater would be "off," which plan was discarded since it operated against the use of day load lamp-socket devices. This defect does not exist in the device described since the dining room, kitchen and bedroom circuits are available for lamp socket appliances without cutting off the water heater.

The accompanying diagram illustrates a simple plan that appears to solve the problem in the light of the above considerations.

Switch A can be realized by a stock snap switch built into the parlor wall. Switch B is the regular throw-over from range to water heater and may be had in snap switch type of 5 kw. capacity for about \$4.00. The diagram shows the water heater connected for flat-rate operation although there is no difference in principle if connected inside of the meter.

This system has the following advantages:

1. It keeps the water heater off the local distribution system peak, which is the important peak to keep away from.
2. It permits water heater to operate even though lamp socket devices are used on all circuits of house except parlor circuit.
3. It is low in price and possesses no complicated automatic features.
4. It will perform its function except when the house is dark in the evening, thus keeping 80 to 90 per cent of the water heaters off of the evening peak.

REPORT ON COLUMBIA RIVER POWER PROJECT.

BY L. F. HARZA.

Appendix H—Canal, Generating Station and Equipment.

Canal. The amount of water to be carried by the power canal would vary between the minimum flow of 50,000 second feet and maximum of about 145,000 second feet at the flood limit of full capacity (flood of 800,000 second feet).

For this canal several locations have been studied, using different widths and bottom elevations. A velocity of about 5.5 ft. per second at maximum flow has been used, the resulting drop from intake to power house being about 1.5 ft. at 145,000 second feet. The section of canal adopted for purposes of estimate would have a bottom width of 325 ft., bottom elevation 70.0 ft., side slopes in rock of 1 on 4 up to elevation 100, and above this, on the river side of the canal, a rockfill wall with concrete lining 1 ft. thick on a hand laid rubble surface to secure watertightness on the canal side of the wall, and also up to the maximum flood level on the river side to prevent erosion of the fill. The slope on the river side would be $1\frac{1}{2}$ on 1 and on the canal side 1 on 1. A section is shown on the general layout, Fig 7 (p. 394, Nov. 20, 1915, issue).

In places along the river side of the wall the normal slope would run out into the river, and a concrete retaining wall has for this reason been provided. At other places where changing section as at the upper end of the canal, rubble or reinforced concrete retaining walls backfilled with loose rock would be used. All retaining walls and the concrete surface on the river side would be provided with frequent weep holes at low points.

For the construction of the canal the S. P. & S. railroad would need to be moved through most of the distance further from the river. This relocation is shown on Fig. 7, the present location being indicated by dotted lines.

No head-gates have been provided for the power canal. They are not believed to be needed for protection of the canal bank, as this structure would be of permanent nature. A boom has been provided near the origin of the canal, diverting to a roller dam in the river wall immediately behind the flood gate piers; also one across the forebay of the power house.

Power house location. Big Eddy is a pool about 1500 ft. in diameter and having a general depth at low stage of probably about 150 to 200 ft., as judged from a few scattered soundings. The bottom along the power house shore deepens on a slope of approximately 2 on 1, as shown by the sounding contours in Fig. 9, (p. 394, Nov. 20, 1915, Journal of Electricity).

The construction of a cofferdam is in general impracticable and resort must be had to setting the power station back far enough from the shore line to permit the use of the natural rock for this purpose; and after completion, the excavation under water of this prism of rock. A core boring was made at the location shown in Fig. 9 and as described in Appendix A, to determine the general character of the rock as bearing upon its tightness for use as a cofferdam. A few small spring channels were encountered but were easily calked. The boring indicated a generally satis-

factory condition, although it is of course to be expected that some grouting of springs would be required. It has been assumed that the natural rock cofferdam be built up in low places by a rockfill timber crib to a crest elevation of 65.00 ft. which would permit continuous work for any discharge less than 200,000 second feet.

Because of the high elevation (about 190) of the rock bench only a short distance back from Big Eddy, and part of which must be excavated for the forebay, it is desirable that the power station be built as narrow and as close to the shore line as possible. Space is not available for its location all in one straight line, as would be preferable, but the location has been so made as to require only one angle. Three locations have been shown in Fig. 7—one (A) by full lines, one (B) by dotted, and location (C) for which the ends only are shown to avoid confusion. In either location A or B it is planned to take the S. P. & S. railroad through an arched tunnel in the power house and to bridge both the forebay and tailrace. This could of course be avoided by making a detour around the end of the power house, but to do so would cost more than the proposed scheme, as indicated by such general information as was available without field survey, for which time and funds were not available. To make this detour would also add greatly to the total curvature of the railroad which would be undesirable.

Location A is preferable to location B, as it would save about 580,000 yards of rock excavation in forebay and tailrace. It would also permit the railroad to pass through the power house nearly at the turn in the latter and at right angles to its direction at that place. It would, however, involve the additional difficulty of constructing the power house across the deep bay of Big Eddy. The maximum depth at low water in this bay along the line of the power station is about 50 ft., and along the line of the cofferdam about 75 ft. A scheme for constructing this cofferdam has been developed and is believed to be entirely feasible at a cost which greatly favors this layout. Although final judgment on this matter must await further field investigations, the success of the cofferdam is believed to be sufficiently assured to warrant the adoption of this project for the estimates.

Location B is justified only to avoid crossing the bay of Big Eddy. In addition to being more costly, it introduces the railroad tunnel in a straight portion of the power house and thus obstructs the view of the entire generator room from the control gallery (which would be located at the bend), which although not essential is always desirable. The tunnel also passes through the power house at a flat angle and thus wastes much space.

Location C is much the cheapest of the three, the saving below location A being about \$885,000, but the upper units would operate under a reduced head because of the drop in the river from their location to where the channel emerges into Big Eddy. It is not known whether this drop is of consequence or not and could not be determined without observations during high water which are not available, although it is known that the water is very swift and turbulent. The upper units in this location would also be exposed to a swift current and to possible ice floes mov-

ing parallel to the power station with danger of injury to the tailrace piers.

Power house layout. The layout for generating station shown in Fig. 7 provides for 24 main generating units although the estimate of machinery will provide for the installation of only 23 units, the additional space being provided for a possible future addition.

Space is shown in Fig. 7 for auxiliary exciter units, if used, between the angle in the power house and the railroad tunnel, although it is probable that exciters mechanically driven from the main generators would be chiefly used. The roof of the railroad tunnel would be about 68 ft. above the generator floor. It, as also the triangular space at the turn, would be built as an elevated switchboard gallery overlooking the generator room in both directions. This triangular space above the generator floor and under the switchboard gallery would be available for offices for the administrative and operating departments. There would be sufficient height for at least three floors in addition to the generator floor and the switchboard gallery on the top. There would be a clear opening along the generator floor of 30 ft. in height underneath the railroad tunnel, thus giving communication along this floor the entire length of the building. The long end of the power house would contain 19 units spaced 65 ft. apart, or with a length of 1235 ft. The short end would contain space for 5 units together with the railroad tunnel and exciter space, altogether 435 ft., making the entire length of building along the forebay or short side 1670 ft.

The generator room as shown in Fig. 8 (p. 389, Nov. 20, 1915, issue *Journal of Electricity*), would be about 76 ft. wide inside. This width is principally determined by the design of the substructure, but in any event should provide sufficient space to permit a generator rotor to be removed and placed on the floor.

The power house would be served by a traveling crane of 250 tons capacity, which is the approximate weight of the generator rotor, the heaviest part to be handled. This crane would be made to serve the entire station by providing a turntable for the truck on the inside, and a circular track for the truck on the outside of the bend in the power house. The trucks at the two ends of a crane are usually interlocked by shafting to which the motive power is applied. In this case the inside truck on the turntable could be temporarily disengaged while making the turn, or rollers on the turntable could be arranged to relieve the load on the rail and permit the wheels to turn without advancing.

The S. P. & S. railroad is now only single tracked; the tunnel would however be built for double track, but the bridges across the forebay and tailrace would be built either for two truss double track or as one-half of a three truss double track, the latter to save initial expense. In the latter case it would be desirable at any rate to provide a timber trestle for the second track to permit its use as a siding during construction. A partition would be built through the tunnel longitudinally between the two tracks. The roof of the tunnel used as a side track would be omitted

during construction and the traveling crane could then unload all equipment directly from the cars.

The building between the gate operating platform and the generator room is capable of being built up to any desired height for such additional space as desired for low and high tension oil switches, transformers, lightning arresters, low and high tension bus-bars and similar apparatus. If used for high tension purposes, the outgoing lines would need to be carried through roof bushings because of the gate operating crane.

This space has been shown built up only enough for low tension apparatus, as it is assumed that most of the power from this station would be used by electro-chemical industries located nearby and using power at generated voltage. The cost of building up this space for high tension apparatus (which would require a redesign of the gantry crane) is properly chargeable to the transformation and transmission costs, which are not to be estimated in detail herein.

Fishladder. A fishladder would be constructed along the tailrace side of the power house as shown in Fig. 8. It would begin at low tailwater elevation at the upstream end of the power house and follow along the entire length of the building and around the farther end to the forebay. It would be supported from the building wall on brackets and would be built as an inclined concrete trough with frequent baffles and occasional deeper and level pools for resting places. Its average grade would be about 5.5 per cent.

Power house substructure. Fig. 8 shows a cross-section of the power house and a sectional plan of one penstock and scroll case. The design here shown was prepared solely for purpose of estimate but is believed to approximate the ultimate design with a fair degree of accuracy.

Each unit would require 65 ft. in length of power house, this length being occupied at the penstock entrance by four water passages each 10.5 ft. wide, three intermediate piers each 4 ft. thick and one main pier 11 ft. thick. The bottom of the forebay as shown is at elevation 69, agreeing with the bottom of the canal. The water would be screened by trash-racks spaced 4 in. apart and supported by horizontal concrete beams spanning between piers. From the entrance the water would flow through a spiral case formed in the concrete and possibly lined with steel, from which it would enter the turbine about the circumference and discharge at the bottom into the draft tube. From here its velocity would be decreased by a gradual expansion of the draft tube until discharged into the river at tailwater level.

Three grooves in the entrance piers are provided for closing off the water. The forward one is for inserting stop logs at rare intervals to make repairs to the guides of the main gate which occupies the second groove. This main gate would be built of structural steel rolling on trucks similar to those proposed for the Camere dam in a former chapter and sealed on all four sides by plates of spring brass. It could be built in one leaf or in two, and would be lifted by the gantry crane by means of chains reaching to the upper platform, or could be grappled in a manner similar to the

Camere gates. If not already heavy enough, it could be weighted with concrete to make it close under full pressure. The third slot is for a light wooden gate of which only a few would be provided; they would be used to deflect the leakage from the main gate into the drainage trough, from which the water would be discharged through a pipe into the tailrace by opening a sluice gate (not shown). A passage through the main piers, also shown in Fig. 8, would be provided with a control sluice gate and stop log slot and used for filling the penstock chamber before opening the main gates.

The forms of water passages here shown have been chosen with the purpose of decreasing as much as possible the center spacing of units and the width of the power house. The penstock entrance has been set low at additional cost for gates, partially to place it well below headwater, but principally to shorten the curve of approach and thus lessen the necessary horizontal distance from gates to turbines and therefore the width of the station. For the same reason the entire scroll case has been shown above the turbine inlet rather than about equally divided as usual. Some objection has been offered to this last feature because of its tendency to change the direction of flow in entering the turbine from that usually obtaining, and redesign might be shown by experiments to be necessary. Time has not been available in which to complete a design of the water passages, the chief purpose being to obtain a basis for estimates. For estimating the yardage of concrete, the deduction for openings has been made from the center line length of same and assumed velocities.

Generating units. The generating station would be equipped with 10 units driven by high head runners having a specific speed at best efficiency of 63, and with 13 low head units of specific speed 85.

The two types of turbine units have been so selected that each would have approximately the same capacity at the maximum head at which it would normally operate and would also operate at the same speed of 75 r.p.m.; so that all generators would be identical. Furthermore, the diameters at the turbine bands would be alike, permitting the use of identical draft tubes, the only difference in water passage being in the height of the turbine inlet or distributors. (This scheme was worked out in detail by Wellman, Seaver, Morgan Co., Cleveland, Ohio.)

Each type of unit would consist of a single cast steel runner with a diameter at the band of 19 ft. 8 in., which would also be the diameter of the upper circular end of the draft tube. The runner would be hung upon the lower end of a forged steel shaft 37 inches in outside diameter with 8 in. hole through the center and about 80 ft. long, built in three pieces. Each turbine would have a capacity under normal conditions of operation of 50,000 horsepower, which would be sufficient for driving the generator at the top. This generator would have a normal rating of 35,000 kilowatts at about 70 per cent power factor and 11,000 volts, with the usual overload capacity.

The character of the prospective loads, such as electrochemical, railroad and irrigation, would permit the use of 25 cycle generating machinery. If the pro-

posed station were to supply surplus power to existing distribution systems for general light and small manufacturing business, 60 cycle would require to be generated by at least part of the units or by motor-generator frequency changers. The estimate has been increased for safety to allow for the use of some of the more expensive 60 cycle generators.

The generator rotor would weigh about 250 tons. The entire rotating element, including the generator rotor, the turbine runner and the shaft, would be carried by a Kingsbury thrust bearing supported by a spider on top of the generator frame. This complete rotor would have a weight of about 650 tons. The runners here proposed would weigh about 150 tons and be too large to be transported by rail in a single piece. They would therefore be cast in four pieces each, and put together on the work.

The nearest approach to turbines of the proposed size which have yet been reached are in the generating station of the Mississippi River Power Company at Keokuk, Iowa, and of the Cedars Rapids Manufacturing & Power Company on the St. Lawrence River about eight miles above Vandreuil, Quebec. The turbine runners at Keokuk have a diameter at the band of about 17 ft. and were partly cast in a single piece and partly in halves. The Cedars Rapids have a band diameter of 17 ft. 7½ in. and were cast in four pieces. It will thus be seen that the proposed runners would be only about 2 ft. larger in diameter than the largest yet built and about 2½ ft. larger than the Keokuk runners, a view of which was shown in plate V, (p. 390, Nov. 20, 1915, issue *Journal of Electricity*). They would moreover be subjected to a much greater head and would need to be built correspondingly strong. They are declared, however, by one of the manufacturers of the Keokuk and Cedars Rapids turbine to be well within the practicable and safe limits of manufacture and transportation. The electrical companies also declare that the manufacture of generators of the proposed size is entirely practicable.

Excitation. Excitation could be provided by the installation of three auxiliary hydraulic turbine driven units, generating alternating current at 2200 volts and each capable of exciting one-half of the main units; each main generator would then have an individual motor generator set for obtaining direct current for excitation. Or individual exciters could be mounted on the generator frame and connected mechanically to the generator. The latter method will be adopted for the estimates because of the large range of heads to which the auxiliary generator turbines would be subjected.

Good lighting as an accident preventive in industrial plants was discussed in a paper recently presented before the Illuminating Engineering Society by R. E. Simpson. In 1910, of 91,000 accidents reported, 23.8 per cent were due directly or indirectly to improper illumination. Numerous examples are cited to show how many of these accidents would have been obviated by adequate lighting. Most accidents were on stairways, passageways, and seldom-used parts of shops, the places most slighted as to illumination.

DIESEL ENGINE PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

Diesel Engines Applied to Marine Purposes.

(Continued.)

In February, 1912, the "Selandia," the first marine Diesel engine installation built by Burmeister & Wain of Copenhagen, was completed. She is a twin-screw vessel with engines of 1000 b.h.p. each, four-cycle.

It may be interesting to note the results obtained with one of the latter Burmeister & Wain engines, by comparing the Diesel ship "Siam" with two steamships "Kina" and "Arabien." The ships belong to the same owners and the voyages are the first made by each ship.

S. S. "Kina" and "Arabien" are single-screw ships of the following dimensions:

Length	385 ft. 0 in.
Beam	53 ft. 0 in.
Draught	26 ft. 10 3/4 in.
Deadweight	8720 tons
Bunker capacity (coal)	770 tons

They were built in 1911 by Swan Hunter & Wigham Richardson and driven by triple expansion steam engines. They are the most economical and latest type of steamships in every respect.

The Diesel-engine ship "Siam" was built and engineered by Burmeister & Wain of Copenhagen. The dimensions are:

Length	410 ft. 0 in.
Beam	55 ft. 0 in.
Draught	30 ft. 6 in.
Deadweight	9700 tons
Bunker capacity (oil)	1250 tons

The voyages made by these ships are the same, so that the results are well suited for comparison.

S. S. "Kina." first voyage June 16, 1911, to November 25, 1911:

Full outbound load in Antwerp—	8720 tons—1162 tons = 7558 tons cargo.
Full homebound load from Sabang—	8720 tons—932 tons = 7788 tons cargo
Mean Cargo—	7673 tons.

Diesel-engine ship "Siam," first voyage, April 9, 1913, to October 4, 1913:

Full outbound load in Antwerp—	9500 tons—493 tons = 9007 tons
Full home load in Hankow—	9500 tons—1168 tons = 8332 tons
Mean cargo—	8670 tons.

From the engine room report of these two ships, the following data are of interest:

	S. S. "Kina." 1st Voyage.	D. S. "Siam." 1st Voyage.
Duration of trip.....	163 days	182 days
Time passed at sea, engine working...	109 days	107.5 days
Time passed in harbor.....	54 days	74.5 days
Distance in miles.....	27,808.0	27,818.0
Numbers of hours regular running....	2,517	2,497
Manoeuvring	92	82
Mean speed, knots.....	11.0	11.14
Number of hours auxiliary engine running starboard		2,127.5
Number of hours auxiliary engine running port		1,666.5
Fuel consumption per mile.....	174.5 kg. coal (384.6 lb.)	40.25 kg. oil (88.7 lb.)
Lubricating oil consumption per I.H.P. per hr.	0.206 gr. (.0072 oz.)	1.64 gr. (.0577 oz.)
Fuel consumption for firing up.....	49.6 tons	0
Stand-by losses	31.6 tons	0
For full steam no propulsion	7.8 tons	0
Regular propulsion	4,415.0 tons	1,061.98 tons
Manoeuvring	71.9 tons	14.74 tons
Electric light	59.6 tons	19.04 tons
Heating	10.7 tons	0.6 tons
Winches and pumps	179.6 tons	23.84 tons
Fuel for main engine	4,576.3 tons	1,076.72 tons
Fuel for auxiliaries	282.3 tons	43.48 tons
Total fuel consumption.....	4,858.6 tons	1,120.2 tons

Economic results for one round trip, Europe, East Asia and back:

	S. S. "Kina." 1st Voyage.	D. S. "Siam." 1st Voyage.
Cargo	7,673	8,670
1000 tons of cargo carried one mile at a speed of about 11 knots at fuel consumption	22.8 kg. coal (50.3 lb.)	4.65 kg. oil (10.25 lb.)
Price of fuel per ton.....	\$5.40 (coal)	\$8.60 (oil)
1000 tons of cargo carried one mile at a speed of 11 knots at fuel expense of	12.3 cts.	4.0 cts.
Total fuel expense for a cargo load of 8500 tons for transportation from Copenhagen to East Asia and back (27,818 miles) at a speed of 11 knots	\$30,300	\$9,900
Outgoing cargo	8720 — 1555 tons = 7165 tons	
Cargo when plying between the West Coast and Japan	8870 — 1085 tons = 7635 tons	
Homebound cargo	8720 — 1120 tons = 7600 tons	
Average cargo for the whole voyage about		7500 tons

From the engine log book of these two ships the following items are of interest:

	S. S. "Arabien" 5th voyage.	D. S. "Siam" 2d voyage.
Duration of voyage.....	300 days	236 days
Time spent at sea engines working....	183 days	140 days
Time spent in port.....	117 days	96 days
Distance in miles.....	45,676	34,819
Number of hours regular running....	4,278	3,279
Number of hours manoeuvring.....	109	88
Average speed, knots.....	10.7	10.6
Number of hours auxiliary engine running port		2,539
Number of hours auxiliary engine running port		2,665
Fuel consumption per mile.....	186.4 kg. coal (410.8 lb.)	41.5 kg. oil (91.5 lb.)
Lubricating oil consumption per I.H.P. hour		0.866 gr. (.03 oz.)
Fuel consumption for firing up.....	66 tons	0
Stand-by losses	77.5 tons	0
Fur full steam no propulsion.....	16.95 tons	0
Regular propulsion	7,600.75 tons	1,357.9 tons
Manoeuvring	102.5 tons	18.3 tons
Electric light	149.75 tons	23.4 tons
Heating	49.25 tons	27.5 tons
Winches and pumps	396.25 tons	18.9 tons
Fuel for main engine.....	7,863.7 tons	1,376.2 tons
Fuel for auxiliaries	670 tons	69.8 tons
Total fuel consumption	8,533.7 tons	1,446 tons

Economic results for trip around the world:

1000 tons of cargo carried one mile at a speed of 10.6 knots at fuel consumption of	25 kg. (55.1 lb.)	4.9 kg. (10.8 lb.)
Price of fuel per ton.....	\$5.40 (coal)	\$8.60 (oil)
1000 tons of cargo carried one mile at a speed of 10.6 knots at fuel expense of	13.5 cts.	4.2 cts.
Total fuel expense for a voyage round the world covering 35,000 miles, which coincides with Diesel engine ship "Siam's case of 8500 tons at a speed of 10.8 knots amounts to	\$40,000	\$12,600

Attention is drawn to the following. The engine room attendance in S. S. "Kina" consists of 3 engineers, 2 assistant engineers and 14 firemen, a total of 19 men. In the Diesel ship "Siam" it consists of 4 engineers, 5 assistant engineers and 4 oil men, a total of 13 men.

S. S. "Kina" bunkered coal 10 times on the voyage. D. S. "Siam" bunkered oil twice on the voyage; the last time so much that the ship on the next trip over the same route only needed bunkering once.

Diesel ship "Siam": Second voyage; trip around the world. From Europe, South America to west coast of the U. S. A., from thence to Japan, China, Vladivostok and back through the Suez Canal:

Outgoing cargo	9500 — 780 tons = 8720 tons
Cargo when plying between the West Coast and Japan.....	9500 — 1056 tons = 8440 tons
Homebound cargo	9500 — 1215 tons = 8285 tons
Average cargo for the whole voyage about.....	8500 tons

S. S. "Arabien"; Fifth Voyage:

The steamship "Arabien" bunkered 14 times during the voyage. The Diesel-engine ship "Siam" bunkered only three times during the voyage, and of these one was caused by a mistake in the execution of the order.

At the end of the trip the remaining oil was sufficient to carry the ship back to the oil-supplying port without bunkering under way. A saving of about 68 per cent in fuel expense is the practical result obtained with the use of the Diesel-engined ship on the voyage. This included all consumption needed for loading and unloading, lighting, heating, etc. The extra saving by smaller crew, bigger cargo-carrying capacity of the Diesel-engined ship were not even taken into account.

The longer the voyages are without stopping, the more economical the Diesel-engined ships are.

The only condition in the choice of route to be taken for the Diesel-engined ship is that it should be such that the ship may enter ports where oil is available.

In 1912 Messrs. Sulzer Bros. installed engines in the "Monte Penedo." The two engines are two cycle, single-acting with four cylinders of 18.5 in. bore and 26.9 in. stroke, having a speed of 160 r.p.m. The data of the ship are:

Length	351 feet
Beam	50 feet
Depth	26.9 feet
Speed	10 knots
Deadweight	4000 tons
Bunker capacity	700 tons
Weight of engines and auxiliaries.....	160 tons
Power	1700 h.p.

The "Monte Penedo" engines are remarkable for the absence of inlet and exhaust valves. The only valves in the cylinder heads are those for fuel injection and starting air. It makes a simple cylinder head but involves complications in the cylinder wall. The exhaust takes place through openings in the cylinder wall forming one-half circle, whereas the other half of the periphery is taken by openings for scavenging air. Of those there are two rows, one above the other, and the communication between the air main and the top row of openings can be blocked by a double-seated valve. This arrangement serves to keep the scavenging air pipe closed at the beginning of the exhaust and then to keep it open after the exhaust is closed, thus preventing the exhaust gases from entering in the air line first and afterward securing an abundance of fresh air at the start of the compression.

The "Monte Penedo" is probably the most successful two-cycle marine motor at present in service. After some trouble with the pistons on the first voyage (the extension required to shut the exhaust and inlet ports worked loose) the construction was altered, and since then the motors have given full satisfaction. It must not be forgotten, however, that these engines were of the best workmanship that can probably be found and were operated by trained engineers.

In 1913 the "Hagen," built by Messrs. Krupp started on her first trip. She is equipped with two single-acting two-cycle engines, each composed of 6 cylinders 18.9 in. bore and 31.5 in. stroke, running 140 r.p.m. The ship's dimensions are: 400 ft. long, 53 ft.

beam and 32.3 ft. depth; carrying capacity, 8350 tons, speed, 11 knots; weight of machinery, 580 tons.

In 1914 the increase of ships with motors is quite remarkable.

Burmeister & Wain of Copenhagen delivered in 1914:

Name	Size of Ship			No. of Screws	
	Length x Beam x Depth.				
Pacific	362 ft.	x 51 ft. 3 in.	x 25 ft. 6 in.	2000	2
Kronprince Gus- taf Adolf ...	362 ft.	x 51 ft. 3 in.	x 25 ft. 6 in.	2000	2
Fionia	410 ft.	x 53 ft.	x 38 ft.	4000	2
Kronprincessin Margarete ..	362 ft.	x 51 ft. 3 in.	x 25 ft. 6 in.	2000	2
Malakka	410 ft.	x 55 ft. x 30 ft.	6 in.	3000	2
Tonking	410 ft.	x 55 ft. x 30 ft.	6 in.	3000	2

Werkspoor of Amsterdam has delivered the engines for:

Name.		Size of Ship		No. of
		Length x Beam x Depth.	I.H.P.	Screws
Elbruz	..... 375 ft. x 40 ft. x 29 ft.		2900	2
Ares	.....345 ft. x 46 ft. 6 in. x 27 ft. 5 in.		2300	2
Artemis	.....346 ft. x 46 ft. 6 in. x 27 ft. 5 in.		2300	2
Selene	.....346 ft. x 46 ft. 6 in. x 27 ft. 5 in.		2300	2
Hermes	.....346 ft. x 46 ft. 6 in. x 27 ft. 5 in.		2300	2
Jules Henry...	305 ft. x 40 ft. x 23 ft		1350	2
Poseidon	.....185 ft. x 30 ft. 6 in. x 13 ft. 3 in.		450	1

(To be continued.)

WATERPOWER DEVELOPMENT ASSOCIATION.

A campaign of publicity, designed to aid the administration in securing the passage of laws to encourage the development of waterpowers in the public domain and the navigable streams, is to be conducted from Washington by the Waterpower Development Association, which is composed of manufacturers of water wheels, hydraulic and electrical machinery, equipment and supplies, whose business has been seriously injured by the stagnation in hydroelectric construction work in the last few years, and who look forward to a revival of the industry and an increased business when the general dam act and the leasing bill for power sites in the public domain, supported by the President and by Cabinet officers, are enacted into law.

In a statement issued by Marcus A. Beeman, secretary of the association, concerning its aims and purposes, it is asserted that the country has been greatly misinformed concerning the facts about the waterpower industry and the legislative situation, and the new organization proposes to carry on a campaign of publicity which will present the facts.

The affairs of the Development Association are in the hands of a committee made up of Harry W. Hand, vice-president of the I. P. Morris Company of Philadelphia, water wheel builders; W. W. Nichols, of the Allis-Chalmers Manufacturing Company of Milwaukee, makers of water wheels and electrical apparatus; Chester W. Larner, of the Wellman-Seaver-Morgan Company of Cleveland, water wheel manufacturers; J. E. Way of R. Thomas & Sons Co. of East Liverpool, O., insulator manufacturers, and Calvert W. Townley, of the Westinghouse Electric & Manufacturing Company of Pittsburgh, manufacturers of electrical apparatus and supplies. Marcus A. Beeman, secretary of the association, has been assistant secretary of the Cleveland and Buffalo Chambers of Commerce, and secretary of the New Jersey State Chamber of Commerce.

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The trend toward the beautiful is quite evident in recent designs of electric power houses and substations. Formerly these structures were erected with a view to fulfilling merely utilitarian purposes. As a result, they were too frequently blots upon the landscape, eye-sores to be shunned. Many an otherwise charming neighborhood was injured by its proximity to a power house or gas plant.

Of late years, however, more taste has been displayed in the construction of these buildings. Beauty was found to be compatible with utility. It was learned that an increase in fitness leads to an increase in beauty. Economy in material brought simplicity and eliminated the superfluous. Ornate embellishment was found to be ugly.

It is astonishing what harmony of form can be created with the most commonplace of building materials. The architect, by the exercise of his ingenuity, constructs an edifice which appeals to the imagination and thereby becomes beautiful.

Nor is this beauty confined to the architectural details. A bit of lawn, a stretch of garden, or even a gravel walk sets off the building and gives to it a distinction which pleases the eye. Vines are trained to hide a deformity, and a few shrubs can be planted to balance an inequality. Every reader can call to mind a number of recent power installation which conform to the dictates of the esthetic, and can realize how ugly these same types of buildings used to be.

The same harmony of form appears in the interior of the plant. Potted palms, tiled walls and flagged floors are not uncommon. Polished metal and marble switchboards make an attractive working place.

Such beauty is not wasted. It makes for better workmen. Operators are more efficient and careful in pleasant surroundings. Cleanliness is thus inculcated and greater safety secured. Fixing up a plant has done away with waste and brought order out of chaos. This tendency toward beauty is one which should be encouraged and commended wherever found.

A remarkable result is being quietly achieved in bettering the electrical trade conditions of the West.

Whereas confusion heretofore existed within and between every branch of the industry, all friction is being gradually removed and a smooth-running organization perfected.

This fact has been made evident by the reorganization of the several state associations of electrical contractors. Last fall the California association was put on a new and better basis, and during the past month the same result has been accomplished with the Oregon and Washington associations.

This improvement is of such importance to the welfare of all concerned that the publication of the new constitution and by-laws of the Oregon association is justified elsewhere in this issue. Next week a similar showing will be made for the Washington contractors, together with a statement of the principles upon which this action is based.

These principles of co-operation, as applied in Cali-

Enhancing Utility by Beauty

foria, have already brought about cordial feelings of reciprocity between central stations, manufacturers, jobbers and contractors—to the financial profit of all. They have ironed out petty differences of opinion and brought a mutual understanding of each other's problems.

The contractor is the public contactor in the electrical business. He meets the consumer and can do much to make or mar public opinion. Through organization it has been possible for the contractor to learn the central station side, to appreciate the difficulties and to co-operate in disarming hostility, in converting ill will into good will. Neither is the bargain one-sided. The contractor has much to gain from the electric company, and is already reaping financial benefits.

One of the problems now engaging the attention of the far-sighted men of the industry is to stabilize merchandising conditions. The contractor has been too much of a mechanic and not enough of a merchant. The electrical business is still a specialty, and electrical purchases require expert advice. With a little instruction in salesmanship, a better appreciation of the need for more attractive salesrooms and a better understanding of business methods, the contractor is far better qualified to advise the purchaser as to his needs than is the non-electrical salesman. These slight deficiencies are to be supplied and thus the contractor-dealer given his legitimate position in the industry.

After these results have been accomplished in the three Coast states, it is hoped to establish the same desirable state of affairs in other states, and later to bring about a better national organization, based upon state representation. This result is being slowly effected without blare of trumpets. The men who are devoting their time to this betterment work should be met with cordiality and assistance. Thus within a few years the electrical contractor will become a prime credit risk, instead of being rated at the bottom, as at present. More power to them!

How to determine the depreciation of public utility properties is a much-mooted problem among engineers for public service commissions and companies. While depreciation is an actual matter of fact, its rate is a theoretical matter of opinion. All engineering structures are subject to a loss in value during the course of time, due either to the natural wear and tear or to inadequacy and obsolescence. As this loss increases, or accrues, with the lapse of time it is known as accrued depreciation.

Many methods have been devised for computing accrued depreciation. The simplest, and perhaps oldest, is the "straight line" method, which assumes that a plant has a definite length of life and a uniform rate of depreciation during its life time. For example, an electric plant may have a life of twenty years and depreciates at the rate of five per cent per annum. After ten years the property will have depreciated fifty per cent in value and after twenty years will have no value. It is like Oliver Wendell Holmes

... wonderful one boss shay,
That was built in such a logical way
It ran a hundred years to a day,

And then of a sudden . . .
. . . it went to pieces all at once,
All at once, and nothing first
Just as bubbles do when they burst.

This method is so simple that it has become a favorite with some engineers who do not seem to realize that simplicity and crudeness may be closely akin. While it is theoretically simple, it is still simply theoretical, and not wholly in accord with the depreciation observed in practice. Because of its crudeness and its failure to coincide with practical observations this method is gradually being superseded by other rules, apparently more complex but really more nearly in accord with the actual conditions existing.

Prominent among these other methods is the "sinking fund" rule which assumes that the time depreciation in value of equipment follows the same law as the time appreciation in value of money at compound interest. While this is a closer approximation to actuality it fails to recognize that the annual cost of repairs tends to increase as a plant gets older and to this extent is an approximation of a more elaborate but more rational formula.

Inasmuch as depreciation is the center about which valuation revolves too much emphasis cannot be placed upon the necessity for care in adopting the most delicate and refined methods of calculation. The straight line rule is such a crude method of computing accrued depreciation that it should be consigned to the limbo and some later and better method adopted in its place.

One further distinction that has too frequently been overlooked is that this theoretical accrued depreciation, however it may be calculated, is not real depreciation in the ability of a composite plant to render efficient service. "It is merely progress toward the necessity for expenditures for maintenance," as is admirably explained by Jared How elsewhere in this issue.

His argument is the same as was sustained last July by the Supreme Court of Idaho in the Pocatello Water Company case. It is based on the fact that a franchise carries with it the obligation to always maintain a composite public utility plant in condition to give efficient service. The plant is not worked to extinction, as is a mine, but is always ready to give as good service as when originally installed. This requires continual replacement of the component parts of the composite plant. The money for this maintenance is derived from the so-called depreciation fund, but is really an operating expense, just as is the oil consumed in operating a steam plant. If it were really a depreciation fund it would be used to amortize the investment and not to replace such portions of the property as shall have been consumed in the service.

To get the full purport of this argument it should be read as published. While some may not agree with its conclusions as a whole, it is certainly suggestive and tends to throw light on a much be-fogged issue. Unquestionably the application of the theory of deducting the theoretical accrued depreciation from the cost of reproducing the plant has deprived stockholders of their rights and the time is now ripe to have the question discussed and conclusively settled.

PERSONALS

C. C. Van Fleet, electrical dealer of Santa Rosa, spent a few days last week at San Francisco.

H. Jacobs, electrical contractor and dealer of Santa Rosa, was a recent business visitor at San Francisco.

W. E. Hayes, of the Hayes Electric Company, of Santa Rosa, spent a few days this week at San Francisco.

C. H. Carter, Los Angeles manager of the Pacific States Electric Company, was at San Francisco last week.

C. W. Dahl, of the Dahl Engineering Company, is again at work, after being recently injured in an automobile accident.

R. E. Frickey, electrical engineer with the Northern California Power Company, has returned to Redding from San Francisco.

Ross Hartley, branch manager of the Pacific States Electric Company, of Portland, Ore., was a recent visitor at San Francisco.

W. T. Goddard, chief engineer and president of the Locke Insulator Manufacturing Company of Hamilton, Ontario, is at San Francisco.

Guy W. Talbot, president of the Pacific Power & Light Company, has returned to Portland from a month's business trip in the East.

E. A. Quinn, general superintendent of the San Joaquin Light & Power Company of Fresno, spent a few days at San Francisco recently.

Wynn Meredith, member of the firm of Sanderson & Porter, has returned to San Francisco after an extended trip throughout the East.

Clem A. Copeland, mechanical and hydroelectric engineer, has established temporary headquarters at the Crocker Building, San Francisco.

Geo. Sherman, Western Electric Company, has returned to San Francisco after a short business trip to Seattle and the Northwestern territory.

A. J. Myers, Pacific Coast manager of the Wagner Electric Company, has returned to San Francisco after a brief business trip throughout Southern California.

A. G. Wishon, general manager of the San Joaquin Light & Power Company, in company with **J. H. Newlin**, purchasing agent, were recent business visitors at San Francisco.

Mr. Kihara, sales engineer of Takata, Japan, and the Japanese representative of the Westinghouse Electric & Manufacturing Company, is a recent arrival on the Pacific Coast.

E. A. West has resigned as efficiency engineer for the Portland Railway, Light & Power Company, to become chief engineer for the Denver Tramways Company, effective March 1, 1916.

Elmer Dover, president of the Oregon Power Company, has returned to Tacoma after completing arrangements for the transfer of the company's main offices from Eugene to Springfield, Ore.

R. C. Dawes, of Chicago, who is interested in gas and electric corporations in all sections of the country, and has spent a lifetime in organizing and directing such companies, is a recent visitor at San Francisco.

W. W. Low, president of the Electric Appliance Company, is at Del Monte, Cal., where he will remain until March 8th. He will then be at the San Francisco office of his company until March 27th, when he will return to Chicago by way of Riverside, Cal., and Dallas, Texas.

W. L. Harraden, lighting expert of the General Electric Company, who recently returned from a business trip throughout the San Joaquin Valley, reports that the education that was given to the public on lighting methods during the Exposition period is beginning to bring returns.

N. Kishi, chief engineer of the Osaka Electric Light Company of Osaka, Japan, arrived at San Francisco recently, from where he expects to start on a tour of inspection of all the large central stations in the United States, which he expects will take him about three months.

Jesse Blair, formerly connected with the Buffalo Engine Company, who has been for the past six weeks at the factory of the Busch-Sulzer Engine Company in St. Louis, watching the construction of one of their engines, which he is going to install and operate in the Hawaiian Islands, has recently arrived at San Francisco.

MEETING NOTICES.

California Section of the National Association of Electrical Inspectors.

The monthly meeting of the association will be held at 706 Ralfo Building, San Francisco, on Saturday, March 4, 1916, at 2:30 p. m. Through the courtesy of the General Electric Company motion pictures of the Schenectady Works, the manufacture of Mazda lamps, and the application of electricity on the modern farm will be shown. These films are of an educational nature so that all members and those interested in the inspection field are urged to be present.

San Francisco Electrical Development and Jovian League.

A large and enthusiastic crowd was in attendance at the February 23d meeting to hear **Loie Fuller** explain the application of electricity in producing the wonderful effects of light and color used in her dances. **R. M. Alvord** presided as chairman, introducing **C. F. Butte** as chairman of the day. **Mr. Butte** had provided some unusual feminine vocal numbers and also introduced **Mrs. A. B. Spreckels** who urged participation in the tombola which is being given for the relief of the Belgian people. **Miss Fuller** gave an interesting account of her early efforts in using electric lights and also demonstrated her methods of decomposing light.

Los Angeles Jovian League.

The regular weekly luncheon was held Wednesday, February 23d, at Christopher's. **Warren C. Kennedy**, secretary of the Baker Iron Works, was speaker of the day and **Roy Layton De Camp**, also of the Baker Iron Works, acted as chairman of the day. President **Holland** announced the winners in the membership contest, the "Reds" under the leadership of **R. C. Starr** defeating the Blues," captained by **R. McHugh**, by a large majority. The winners will be entertained with a dinner at the expense of the losers. **Mr. Kennedy** who was formerly president of the Los Angeles Credit Men's Association, spoke on "Credits." He emphasized the importance of properly securing accounts either with contract, chattel mortgage, note with collateral security, trust deed, or bond; and stated that in extending credit it is his opinion that resources and character should be the principal considerations, and also that "An ounce of prevention is worth a pound of cure." He said in part: "A proper understanding of credit carries with it need of being posted on collateral subjects such as commercial law, costs of doing business, general financial and banking problems, accounting, cost keeping, fire, life, compensation, credit and marine insurance, experience in buying and selling, advertising, efficiency, legislation and taxation." Several pleasing numbers completed the program.

California Association of Electrical Contractors and Dealers.

The monthly dinner of the association was held at an Oakland cafe on Friday evening, February 25th, there being 85 in attendance. **Robert King**, as toastmaster, first introduced **Mr. Bredhoff**, secretary of the general contractors' association of Oakland, who gave an interesting address on the relationship which should subsist between the general contractor and the sub-contractor. He congratulated the electrical men on the effectiveness of their organization and suggested that similar associations among the other trades would

be to the benefit of all. The relationship of all branches should be amicable, it should discourage peddling of bids and should encourage fair play and fair dealing.

John Bray, credit man for the Western Electric Company, then read a suggestive paper on "Co-operation between the Contractor-Dealer and the Credit Man." He urged the contractor to seek the credit men's advice as a business efficiency expert as regards better office methods and in showing the relation of expense to sales or profits. He explained how the granting of long credit terms decreases the jobber's profit by decreasing the turn over on the investment. With a merchandise investment of 60 days, a 60-day receivable investment, as compared with 30-day collections, gives a turn-over of three times a year instead of four, a loss of 25 per cent on the net profit through carrying the receivable investment an extra thirty days. Accounts that run continually over 90 days are unprofitable. He also showed how easy credit terms worked to the disadvantage of the established contractor and dealer. He offered the assistance of the credit men in helping the contractor increase his sales, increase his profit, help his collections and keep down losses from bad accounts.

Robt. Martland, formerly an electrical contractor and now secretary of the California Automobile Supply Dealers' Association, gave a spirited and inspiring talk on the benefits of organization. In 19 months his association has grown from nothing to 600 members, credit conditions are 80 per cent better, and ruinous price cutting has ceased. He suggested that it is better to lay awake at nights trying to figure how to maintain the organization and not how to beat it.

J. W. Redpath, secretary of the association, told briefly of the encouraging conditions of the association.

W. L. Goodwin, after recounting the deplorable state of affairs that has existed among the Washington electrical interests, announced the recent organization of the Washington association and the re-organization of the Oregon association along the same lines as have been adopted in California. He also emphasized the advantage of a contractor being a dealer.

R. H. Holabird told of progress in the socket appliance campaign being conducted in conjunction with the Pacific Gas & Electric Company. C. C. Hillis warned the contractors to remember the recent advance in the prices of materials when figuring jobs, so as to allow adequate profit. Other speakers spoke briefly on similar lines, after which the meeting was adjourned.

PINCHOT OPPOSES WATER POWER LEGISLATION.

The following letter to the editor outlines the plans of Gifford Pinchot to defeat the Congressional legislation for the development of water power. It is published for the information of Western men and indicates the extreme to which this campaign is being carried:

To the Editor—Sir:

I write to ask your help to defeat a most serious attack on our public resources. Since the fight over the Alaska resources was won there has not been so pressing a threat against the conservation policy as the present effort in Congress to give our public water powers for nothing into monopolistic control.

The Shields Bill, now before the Senate, gives to the power interests without compensation the use of water power on navigable streams. The amount of water power these streams will supply is larger by far than all the power of every kind now in use in the United States. It pretends to, but does not, enable the people to take back their own property at the end of fifty years, for in order to do so under the bill, the Government would have to pay the unearned increment, and to take over whole lighting systems of cities and whole manufacturing plants. Private corporations are

authorized to seize upon any land, private or public, they choose to condemn.

Bills which gave away public water powers without due compensation were vetoed by President Roosevelt and President Taft. The Shields Bill would do precisely the same thing today.

Another water power bill, the Ferris Bill, relating to the public lands and National Forests, was in the main a good bill as it passed the House. As reported to the Senate, it encourages monopoly by permitting a corporation to take as many public water power sites as it may please. Under it the corporations could not even be kept from fastening upon the Grand Canyon, the greatest natural wonder on this continent. This bill takes the care of water powers on National Forests from the experienced and competent Forest Service, and gives it to the Interior Department, thus entailing duplication and needless expense.

In my opinion, there is undue carelessness as to the disposal of public resources at present in Washington. The water power legislation now before the Senate is too favorable to the men who, as Secretary Houston's admirable recent report shows, control through 18 corporations more than one-half of the total water power used in public service throughout the United States. The water power men charge that conservation hampers development. The Houston report shows, on the contrary, that the most rapid development is in the National Forests, where conservation is best enforced. On the other hand, 120 public service corporations own and are holding undeveloped and out of use an amount of water power equal to four-fifths of all there is developed and in use by all the public service corporations in the whole United States.

As I said in an open letter of January 29th to the President:

"Natural resources lie at the foundation of all preparedness, whether for peace or for war. No plan for national defense can be effective unless it provides for adequate public control of all the raw materials out of which the defensive strength of a nation is made. Of these raw materials water power is the most essential, because without electricity generated from water power we can not manufacture nitrates, and nitrates are the basis of gunpowder. There are no great natural deposits of nitrates in the United States as there are in Chili. It would be folly to allow the public water powers, which can supply this indispensable basis of national defense, to pass out of effective public control."

A concerted movement is on foot to break down the conservation policy. Feeble resistance or none at all is being made by official Washington. Unless the press and the people come to the rescue, the power interests are likely to win. This is a public matter wholly removed from political partisanship. Your help is needed, and that of your paper. For nearly ten years this fight for the public water powers has gone on. We ought not to lose it now.

Sincerely yours,

Milford, Pa., Feb. 15, 1916

GIFFORD PINCHOT.

NEWS OF OREGON PUBLIC SERVICE COMMISSION.

April 17th has been set as the date for hearing the complaint asking for an interchange of telephone service between the Pacific Telephone & Telegraph Company and the Home Telephone Company.

NEW CATALOGUES.

The Western Electric Company has a new edition, the sixth, of the complete little handbook "How to Figure Illumination" ready for distribution. This booklet lists complete tables and full illuminating data as well as illustrating and describing with complete characteristics all the various sizes and styles of Sunbeam Mazda lamps.

CONSTITUTION AND BY-LAWS OF THE OREGON ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS, ADOPTED FEB. 9, 1916.

Section 1. The name of this association shall be the Oregon Association of Electrical Contractors and Dealers.

Sec. 2. Its objects are to promote the welfare of its members and to distribute among them the fullest information obtainable in regard to all matters affecting the business of the electrical contractor and dealer.

To encourage its members in establishing attractive retail stores where the consumer may obtain his requirements of electrical material.

To aid in bringing about a more friendly relation between the electrical contractors and dealers, and to promote home industry by co-operation with manufacturers and wholesalers, who maintain stocks and organizations in the territory of its members.

To assist in standardizing and marketing high grade electrical merchandise of American manufacture and by encouraging the proper installation reduce the fire hazard by co-operating with the National Fire Protection Association, the Board of Fire Underwriters of the Pacific and local municipal electrical inspection departments.

To improve the standard of specifications by co-operating with the American Institute of Electrical Engineers, American Institute of Architects and local chapters of same, Northwest Electric Light & Power Association and municipal lighting and power plants and by closest co-operation assist them in solving the problems which will improve the service to the consumer.

To encourage the more general use of electrical appliances by encouraging its members to affiliate with and support the work of the Society for Electrical Development.

To encourage and support local Electrical Development Societies.

Sec. 3. The general offices, as well as branch offices, shall be located at such places as the executive committee may from time to time determine.

Sec. 4. The jurisdiction of the Association shall extend to all places within the boundaries of the State of Oregon.

Sec. 5. Application for membership must be made in writing to the secretary-treasurer of the association, and must be accompanied by an amount equal to the initiation fee and the first quarter's dues in accordance with Section 12.

Sec. 6. The membership shall be composed of regular and associate members. A regular member is an individual, firm or corporation in Oregon engaged exclusively as an electrical contractor or dealer.

Sec. 7. Associate membership shall be divided into two classes, namely: "A" and "B."

Class "A" membership comprises all central stations, municipal light and power plants, telephone companies and electrical railroad companies and companies of like character.

Class "B" membership shall comprise any individual, firm or corporation, except those qualified as regular or Class "A" Associate members engaged in any branch of the electrical business, but who do not do installation work, and also any retailer handling electrical material but not engaged exclusively in the handling of the same, and also any electrical dealer or contractor coming within the division of a regular member, but operating in a territory outside of the State of Oregon and also electrical engineers.

Sec. 8. For the purpose of determining whether an individual, firm or corporation is engaged in the business of electrical contractor or dealer, the following definition shall be used:

An electrical contractor or dealer shall be any individual, firm or corporation carrying a general stock of electrical supplies or who may be prepared to make electrical installations.

He shall have an established location where he transacts his business with the public and must have displayed any ordinary sign or placard announcing the character of his business,

and shall maintain the usual set of books and records incident to the conduct of any ordinary business.

He shall carry a stock of electrical supplies of not less than two hundred and fifty dollars, (\$250) for the performance of electrical installation work.

He shall not engage in the use of such tools for the purpose of making installations, nor perform any physical labor usually performed by mechanics hired for the purpose, provided however, that in a firm composed of two persons (other than husband and wife) or more, one of them may perform the services of an ordinary mechanic.

No member of a firm engaged in the use of tools in installation work shall represent his firm in this association.

But the executive committee, by the concurrent vote of not less than two-thirds thereof, may admit to membership any electrical contractor or dealer, who does not qualify in all respects, under the above definition.

Sec. 9. The membership shall stand in the name of an individual, as representing the person, firm or corporation and the secretary-treasurer shall recognize such persons as authorized to represent as a member such person, firm or corporation with power to vote at meetings.

Each individual, firm or corporation shall be entitled to name, in addition to the representative in whose name its membership shall stand, an alternate, but no individual, firm or corporation shall change its representative, or alternate, during any fiscal year of the association, except with the approval and consent of two-thirds of the members present at any general meeting, or two-thirds of the executive committee present at an executive meeting.

Sec. 10. A Membership Committee shall pass on all applications for membership.

The membership committee shall comprise not less than five members inclusive of the president, a vice-president and three members at large in the city or territory from which the application originates.

The members at large shall be appointed by the president when applications are received.

Any applicant who receives a majority vote of the membership committee shall be declared duly elected. If the applicant does not receive a majority vote of the membership committee, it shall be the duty of the secretary-treasurer to submit the application at the first regular meeting following of the association. Applications will then be submitted to the members at large, together with a full report from the secretary-treasurer, giving the result of the votes of the membership committee.

If the applicant receives a two-thirds vote of members voting at any regular session, he shall be declared duly elected.

Sec. 11. The fiscal year shall begin the first day of January of each year and shall end on the following 31st day of December.

Sec. 12. The initiation fee of all classes of members shall be \$10.00 and the annual dues shall be \$36.00. The dues shall be paid quarterly, in advance, on the 1st day of January, April, July and October.

If, however, any member remits for his dues within thirty days after due date for the fiscal year he shall be entitled to a discount of 20 per cent.

Every member shall pay dues for the quarter during which he is elected as follows: If elected during the first month of such quarter he shall pay full dues for such quarter; if elected during the second month of such quarter, he shall pay two-thirds of such dues; and if elected during the last month of such quarter, he shall pay one-third of such dues.

Sec. 13. Any regular member operating a branch house shall pay additional dues for said branch equal to 50 per cent of the dues of any regular member and subject to the same discount. For the purpose of determining what is a branch house, the following definition shall apply: A branch house shall comprise an establishment operating as is defined in

the definition of a regular member, provided, however, that said branch is operated under the identical name of the main house. If, however, the name of the branch differs in any way from the name of the main house it shall be constituted as separate membership. Nothing in this definition shall be construed as meaning that a branch shall be defined where a regular member establishes a temporary office in another location for the purpose of making an individual installation.

Class "A" Associate Membership entitles the said Class "A" Associate Member to nominate one representative and one alternate, one of whom may attend all meetings of the association and receive all literature distributed.

Class "A" members may appoint additional representatives who will have the privilege of attending all meetings and receive all literature distributed by the association upon the payment of \$1.00 per year for each additional representative so named.

Associate members shall be entitled to attend all meetings of the association and receive all literature distributed, but shall not however, be entitled to vote.

Sec. 14. Upon majority vote of the executive committee, the initiation fee may be suspended or reduced for a period not exceeding any one quarter, and in the event of the reduction of the initiation fee, the executive committee shall determine the amount of initiation fee during the quarter so affected.

Sec. 15. Any member may be expelled from the association for non-payment of dues, after a period of ninety (90) days from the date when the said dues become due and payable.

The membership of any member suspended as aforesaid who fails to pay such dues within ninety (90) days after suspension shall as a result of such failure and without further action in the premises terminate unless said period of ninety (90) days be extended by the executive committee, in which case his membership shall without further action terminate at the end of the extended period.

Sec. 16. Subject to instructions given by resolution passed in general meeting, the management of the association's affairs shall be vested in the executive committee.

In the absence of instructions on any subject, the said executive committee shall have power to act at its discretion, but its action shall be subject to the subsequent alteration, amendment or repeal by the members present at any subsequent meeting.

Sec. 17. The officers of the association shall be a president, elected by ballot at the annual meeting of the association, as many vice-presidents as there are territories, elected as is hereinafter specified and a secretary-treasurer, who shall be chosen by the executive committee as hereinafter specified.

Sec. 18. The Executive Committee shall be comprised of the president, vice-presidents from each territory, elected as hereinafter specified, and two members at large.

Only individuals representing regular members shall be qualified to act as members of the executive committee.

In the event that it is impossible for any member of the executive committee to attend any meeting of such committee the secretary-treasurer may appoint a substitute located in the same district as such member to attend in his place.

Sec. 19. As many vice-presidents as there are districts shall be elected by ballot at the annual meeting and shall hold office for one year or until their successors are elected and qualified.

The members to be voted on for vice-presidents representing particular districts shall be chosen as follows:

The members located in each district shall, five days previous to the annual meeting, send to the secretary-treasurer of the association for election as a vice-president, the names of one or more members, located in their district, which names shall be submitted for vote at the annual meeting and the member for whom the highest number of votes are cast shall be declared elected vice-president for such district.

The members in each district may determine in any manner they deem best the name or names to be submitted for vice-president.

Upon failure of the members of any district to nominate in accordance with the above section, one or more members for election as vice-presidents, the executive committee is empowered to elect a member from such district to fill the vacancy.

There shall be nominated by the regular membership in each territory, from the regular members a vice-president, provided, however, that where the total regular membership in any territory is more than ten, an additional vice-president shall be nominated for each additional ten regular members or fraction thereof.

Sec. 20. The executive committee shall have the power to appoint such sub-committees as it may from time to time deem necessary.

Sec. 21. The entire state will be divided into three districts, to be numbered from one to three respectively and the territory included in each district shall be as follows: District No. 1, All that part of the state lying west of the Cascade Mountains and north of the 45th parallel of latitude, including Salem, Oregon. District No. 2, All that part of the state lying west of the Cascade Mountains south of Salem and the aforesaid parallel. District No. 3, All that part of the state lying east of the Cascade Mountains.

Sec. 22. The secretary-treasurer shall be chosen by the executive committee and his compensation shall be fixed by such committee. He shall keep the books of the association and shall perform such duties as may be delegated to him by the executive committee.

Sec. 23. Where it is deemed advisable to establish district offices of the association, the members of all such districts to be covered by such branch office may select an assistant secretary, who shall be subject to the orders of the executive committee and of the general secretary.

The salaries of the district secretaries shall be fixed by the executive committee.

Sec. 24. The secretary-treasurer of the association shall be custodian of the association funds. He shall deposit such funds with banks or trust companies approved by the executive committee and shall file with each of such banks and trust companies a copy certified by the president, of section 24 of these by-laws.

He shall furnish a bond in an amount to be determined by the executive committee and the expense of such bond shall be borne by the association.

The executive committee shall employ a certified public accountant who shall annually audit the account of the secretary-treasurer. Such public accountant shall file a written report of his investigation with the president and such reports shall be read at the next regular meeting.

The executive committee shall appoint a committee of five of which the president and secretary-treasurer shall be members, to have control of and to direct the disposition of the funds of the association. No limitation shall be placed upon said committee's power to draw on and distribute the funds. The action of this committee must have the consent and approval of a majority of its members.

Sec. 25. The association shall hold a general meeting at least once in every ninety days at such time and place as may be determined by a majority vote of members present at any previous meeting.

Sec. 26. The executive committee shall designate one of the quarterly meetings as the annual meeting.

Sec. 27. Meetings of the executive committee shall be held upon request of three of its members or upon the call of the president or secretary-treasurer at such time and place as may be designated by them or him.

Sec. 28. Each and every action taken at any quarterly

meeting must be in conformity with the constitution and by-laws of the association.

Sec. 29. A majority of all members of any committee shall constitute a quorum.

Sec. 30. The members present at any quarterly meeting shall constitute a quorum.

Sec. 31. A vote on any question by any members of any body or committee may be taken by mail or telegraph and such votes shall have the same force and effect as though given at a duly convened meeting.

Sec. 32. The president shall preside at all meetings and in the event of absence of the president at any meeting, by majority vote of the members present, one of the vice-presidents shall act as chairman of the meeting.

Sec. 33. The executive committee shall elect annually as counsel, a regular practicing attorney, prescribe his duties and determine his compensation.

Sec. 34. Resignations shall be addressed and sent to the secretary-treasurer and shall be thereafter acted upon at the next meeting of the executive committee and the member resigning shall be amenable to all rules and regulations of the association to the date of such meeting.

Sec. 35. By a two-thirds vote of the entire executive committee, any member may be expelled for cause, provided, however, that such member is given an opportunity to be heard before the said committee. On the question of such expulsions neither the accusing nor the accused member shall be entitled to vote.

Sec. 36. The constitution and these by-laws may be revised and amended at any general meeting provided that such revisions or amendments are submitted in writing to the secretary-treasurer at least thirty days in advance of any regular meeting. It shall be the duty of the secretary-treasurer to forward to each member at least ten days in advance of any regular meeting copy of such proposed revision or amendment.

Sec. 37. Except where otherwise provided Roberts Rules of Order shall govern the parliamentary procedure of this organization.

Oregon Electrical Contractors' Association.

Beaver Electric Co., Portland, Ore.
Boicourt Electric Co., Portland, Ore.
Grand Electric Co., Portland, Ore.
H. M. & H. Electric Co., Portland, Ore.
E. L. Knight & Co., Portland, Ore.
Morrison Electric Co., Portland, Ore.
NePage, McKenney Co., Portland, Ore.
Pierce, Tomlinson Electric Co., Portland, Ore.
Robt. Skeen Electric Works, Portland, Ore.
Smith, McCoy Electric Co., Portland, Ore.
Portland Electric Mfg. Co., Portland, Ore.
Walker Electric Works, Portland, Ore.
M. J. Walsh Co., Portland, Ore.
West Coast Engineering Co., Portland, Ore.
Western Electric Works, Portland, Ore.
Burgey Electric Co., Vancouver, Wash.
Cole & Cummings, Corvallis, Ore.
V. I. Fuqua, Forest Grove, Ore.
J. B. Hope, Electrical Supply Co., Lebanon, Ore.
Hunter Electrical Co., Eugene, Ore.
Newton Electric Supply Co., Albany, Ore.
Owl Electric Co., Hillsboro, Ore.
Ewart Electric Co., Astoria, Ore.
Pettingell, the Electrician, Salem, Ore.
B. W. Paul, Medford, Ore.
Ralston Electrical Supply Co., Albany, Ore.
Salem Electric Co., Salem, Ore.
Scott Electric Co., Astoria, Ore.
Smith & Ellison, Dallas, Ore.
Standard Electric Co., McMinnville, Ore.
The Dalles Electric Co., The Dalles, Ore.
J. L. Vaughan, Pendleton, Ore.
Welch Electric Co., Salem, Ore.
Fred B. West, Dallas, Ore.
Witzig Electric Co., Corvallis, Ore.

TRADE NOTES.

The Alexander & Lavenson Electrical Supply Company, who were formerly at 633 Howard street, recently moved their offices to 168 Second street, San Francisco.

The Ward Leonard Electric Company, Bronxville, N. Y., manufacturer of electric devices, has appointed John B. Sebring Company, Baum boulevard and Euclid avenue, Pittsburgh, Pa., as their district sales agent. Mr. Sebring is well known in the Pittsburgh community.

NEW CODE RULING ON KNOBS.

A time limit of June 1, 1916, has been set by the Board of Fire Underwriters of the Pacific to discontinue the use of non-Code split knobs, No. 5½ solid knobs and single braid wire in sizes of No. 6 B. and S. gage and larger. This date was determined only after a survey of stock on hand in this territory so that it is felt that undue hardship will not be wrought.

Sec. 64-C of the Code requires No. 5½ circular split knobs to be one and one-eighth inches in diameter and to afford the wire at least one inch separation from the surface wire over. The split knob heretofore most commonly used in this territory has a diameter of one inch. Sec. 16-b requires that split knobs must be used for the support of conductors smaller than No. 8 B. and S. gage. This will require the use of split knobs at all locations for wires smaller than No. 8 B. and S. gage. The present rule requires solid knobs at turns, strains, dead ends, etc., but split knobs must now be used at these points.

In amending this rule by the Electrical Committee of the National Fire Protection Association it was felt that with the small wires they could not be properly supported by tying to solid knobs.

Sec. 26-27, and 28 require wires to be double braided for sizes No. 6 B. and S. and larger. This amendment will govern for all classes of construction. The above provisions have been agreed to by members of the California Section of the National Association of Electrical Inspectors, so that a uniform application of the new rules is looked for.

NATIONAL ELECTRICAL CONTRACTORS' CONVENTION.

The 16th annual convention of the National Electrical Contractors' Association will be held at New York City July 17-22, 1916. The headquarters will be at the Hotel McAlpin. The following program has been prepared:

Monday, July 17th—10 a. m., meeting of the National Executive Committee.

Tuesday, July 18th—10 a. m., meeting of National Board of Directors.

Wednesday, July 19th—10 a. m., opening of convention. Session open to all. Speakers: Address of Welcome, Lewis H. Woods, president New York State Association; address by John R. Galloway, president the National Electrical Contractors' Association; address by Hon. John Purroy Mitchell, mayor of New York City; James H. McGraw, president of the McGraw Publishing Company, subject, "The Society for Electrical Development and Its Relation to Merchandising"; T. Commerford Martin, official secretary National Electric Light Association; Arthur Williams, New York Edison Company; 2 p. m., business session, open to members only; 9 p. m., reception and dance in the blue and green room, Hotel McAlpin.

Thursday, July 20th—10 a. m., business session, open to all in the electrical contracting business, whether members or not; 10:30 a. m., ladies to visit one or more department stores for parade of gowns, etc.; 2 p. m., business session for members only; 2:30 p. m., for ladies and guests, exhibition of Aeolian and new talking machine at Aeolian Hall, 42nd street; 7 p. m., automobile ride to Coney Island.

Friday, July 21st—10 a. m., business session for members only; 3 p. m., special train on Long Island road, leaving Pennsylvania Station, to Hotel Trouville, Long Beach; 4 to 6:30 p. m., surf bathing, etc., at Long Beach; 6:30 p. m., dinner-dance and entertainment.

Saturday, July 22d—9 a. m., organization meeting of the National Board of Directors; 10 a. m., organization meeting of the National Executive Committee; 11 a. m., leave hotel for special boat, "Seeing New York by Water," a complete circle of the city will be made and light lunch served on board, landing about 4 o'clock.



NEWS NOTES



ILLUMINATION.

PETALUMA, CAL.—The Cinnabar Lighting District was organized at a recent election.

SILVERTON, ORE.—The Portland Railway, Light & Power Company is preparing to extend its service to East Silverton.

OAK HARBOR, WASH.—A franchise for a lighting and water system at Oak Harbor has been granted the Whidby Island Electric & Power Company.

PASADENA, CAL.—The county supervisors have set the date for the election looking to the formation of Lamanda Park ornamental lighting district for March 18th.

RED BLUFF, CAL.—The city trustees have awarded the contract for the installation of a lighting system on Main street to the Northern California Power Company on its bid of \$2850.

CASA GRANDE, ARIZ.—This place has voted bonds for a municipal water, electric light and ice system. Proposals for bids relating to the construction of the plant will be published at once.

LOS ANGELES, CAL.—The board of supervisors has heard protests on the formation of the Graham Lighting District and has adopted a resolution calling an election to be held March 18th.

POMONA, CAL.—The city council has ordered that cast iron lighting posts and appliances for street lighting purposes, be installed on Park Drive, Kenoak Drive, South Kenoak Drive and Orange Grove Avenue.

SANTA BARBARA, CAL.—It is reported that more than 50 per cent of the frontage on State street between De la Guerra and Yanonali streets has been signed for ornamental lights. It is hoped to get enough signers to carry the work along the remaining two blocks to the beach. The council will be asked to create a district and order lights installed on the front foot plan.

TRANSMISSION.

PASADENA, CAL.—It has been learned that Pasadena has acquired a right of way for a municipal power line to the city limits of Los Angeles. It is reported that this is to be leased to Horace M. Dobbins, owner of the railroad right of way.

NORTH YAKIMA, WASH.—The Pacific Power & Light Company will reconstruct the Sunnyside substation, installing a loop and oil switches. Distributing lines will be extended west from Sunnyside to connect with those from Toppenish.

SPRINGFIELD, ORE.—Following the sale of the Oregon Power Company's distributing lines and substation to the City of Eugene, the company's chief office will be moved from Eugene to Springfield, where the company's largest plant is situated.

BARSTOW, CAL.—The Southern Sierras Power Company is making arrangements to extend its lines from Kramer to Barstow. From Barstow power will be distributed to the Hinkley valley and then east by way of Yormo and Newberry to Ludlow and Needles.

CLAREMONT, CAL.—Application has been made to the board of trustees by the Southern California Edison Company for a 30 year franchise to distribute electric energy to be used for any and all purposes. Sealed bids will be received for said franchise up to April 3d.

YREKA, CAL.—The new management of the California-Oregon Power Company will shortly commence extensive developments at Copco, this county. Additional men have been employed to rush the work. The power dam will be

raised to an elevation of 60 feet if present plans are carried out.

PORTERVILLE, CAL.—E. G. Shore, superintendent of the Porterville division of the Mt. Whitney Power Company, appeared before the city council last week to secure a permit for the construction of the new substation which the corporation is to erect on its property at Putnam avenue and Fourth street. The plant, it is stated, will represent an investment of \$40,000.

AUBURN, CAL.—Preparations are under way for the erection of the Wise power house, the lowest on the Drum system of the Pacific Gas & Electric Company. The company has transferred its force from Christian Valley to Auburn Ravine, just below town, and things are being gotten into shape for the erection of the cement foundations for the building, machinery and penstock.

SPOKANE, WASH.—At a point where the Pend Oreille River is confined within a channel 18 ft. wide in the Zig-Zag canyon below Metaline Falls, surveyors and engineers are completing exploration work preparatory to the erection of a dam and power plant capable of generating 400,000 h.p. It is supposed that considerable of the power will be taken by the Milwaukee railroad in the electrification of its Idaho & Washington Northern line and other branches.

TELEPHONE AND TELEGRAPH.

UKIAH, CAL.—The McDowell Valley Rural Telephone Company was organized at a meeting in Hopland. A new telephone line 7 miles long is planned.

RICHMOND, CAL.—Bids will be received up to March 20th for a 41 year telephone franchise, as applied for by the Pacific Telephone & Telegraph Company.

PLAINSBURG, CAL.—The Plainsburg Rural Telephone Company has been organized by farmers of Plainsburg, Le Grande and vicinity. E. D. Kahl is president and E. L. Motley secretary.

HAILEY, IDAHO.—The business men of Bellevue and farmers of Glendale and Stanton have taken steps to construct a rural telephone line that will connect every ranch in the two precincts.

LOS ANGELES, CAL.—As the result of a careful canvass of fifty widely varying lines of business using the pay telephone, Fulton Lane, president of the public utility commission, has filed a report with the city council that 66 per cent are well satisfied with the system, 30 per cent expressed dissatisfaction and 4 per cent were indifferent. The report shows that 60 per cent of the money received by the telephone companies from this source come from tourists and out-of-town people, and the conclusion drawn by President Lane is that this service is more economical and beneficial to the present subscribers than was the old system.

TRANSPORTATION.

PORTERVILLE, CAL.—Plans for laying several miles of track along the foothills in the Porterville section and electricizing this part of the system are under consideration at the present time by the Southern Pacific Company. In general the plan is to build a line from Merryman on the Visalia Electric east of Exeter south along the foothills, about two miles east of the main line, through the El Mirador colony and Frazier Valley to Success, where connection will be made with the Porterville Northeastern. It is also planned to build a line from a point near Adobe on the P. N. E. south along the foothills for several miles, connection with the main line to be made at Ducor. Cross lines from the foothill lines to the main line are to be built at various points.

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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VOL. XXXVI NO. 11

SAN FRANCISCO, MARCH 11, 1916

PER COPY, 25 CENTS

SAN FRANCISCO'S NEW PATH OF GOLD.

GOLDEN GATE CABLE INSTALLATION.

BY S. J. LISBERGER.

DIESEL ENGINE APPLIED TO MARINE PURPOSES.

BY J. S. MEGSON AND H. S. JONES.

ESTIMATE OF CAPITAL COST OF COLUMBIA RIVER
POWER PROJECT.

BY, L. F. HARZA.

"WIRE YOUR HOME" MONTH.

BY JOHN A. RANDOLPH.

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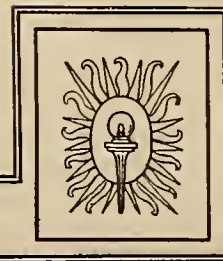
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JOURNAL OF ELECTRICITY

POWER AND GAS



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VOLUME XXXVI

SAN FRANCISCO, MARCH 11, 1916

NUMBER 11

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SAN FRANCISCO'S NEW PATH OF GOLD

Some months ago the Downtown Merchants' Association of San Francisco concluded that a new lighting system was needed along Market street, the main thoroughfare of the city. Consequently W. D'A. Ryan, chief of illumination for the Panama-Pacific International Exposition, was requested to design an effective means of illumination. After a thorough study of the conditions Mr Ryan recommended the use of luminous arc lamps mounted on standards to be supported by the existing trolley poles along the street. Each standard carries three lamps mounted in the form of a triangle as is shown in the accompanying illustration which shows the type adopted.

This ornamental standard is to replace the present top piece. It carries three luminous arc lamps provided with a new form of glass-ware to better diffuse the light. The standards are 29 ft. in height and are to be spread at an average of 110 ft. intervals on either side of the street. In the 1.42 miles from the Ferry to Seventh street, 137 poles will be thus equipped. In addition 16 lamps are to be installed on four standards in front of the Ferry Building by the Board of Harbor Commissioners and 4 three-light standards will be erected by the Palace Hotel along New Montgomery street.

The system is to be installed by the Pacific Gas & Electric Company, including lamps, cable, rectifiers and other station apparatus, at a cost of approximately one hundred thousand dollars. The top light on standard is to be wired on a separate circuit and is to be maintained by the city as an all-night light. The two side lights are to be maintained jointly by the mer-

chants, property owners, United Railroads and others.

This system will make Market street one of the most brilliantly lighted thoroughfares in America. The three lamp units will give about fifteen times the present illumination with a current consumption three times as great. Each lamp develops 1900 c.p. at a current consumption of 530 watts, though the tinted glass globe will absorb about a quarter of the light. Not only will the street and sidewalks be illuminated, but also the full facade of each building.

The luminous arc lamps are those which were used at the Panama-Pacific International Exposition. Similar lamps, though not so many in such an area, have been installed in over a hundred cities, something over fifteen thousand units now being used for street lighting.

Such lighting as this should be a continuous advertisement for the city as well as increasing the safety of traffic. The stores will be benefited by increased patronage due to superior attraction of brightly lighted streets, and the police will find less rowdyism and theft. Good lighting is a paying investment for any community.

Mr. Ryan has stated that this system, which will be known as the San Francisco system, is scientifically correct, and will give the proper amount and kind of light on the street and sidewalks, but it has a very important additional feature. It is decorative, and will give Market street the appearance at night that it should have, a distinction

and tone; in other words, in keeping with its character. Present-day methods of street lighting require correct mounting and arrangement of lamps.



Proposed Lamp Standard.

GOLDEN GATE 11,000 VOLT CABLE INSTALLATION.

BY S. J. LISBERGER.

(The method whereby the Pacific Gas & Electric Company successfully laid an 11,000 volt cable under the San Francisco Golden Gate is here described. The story is arranged from a paper presented by the author before the San Francisco Section of the American Institute of Electrical Engineers, Feb. 25, 1916. Mr. Lisberger is engineer of electrical distribution for the company.—The Editor.)

Heretofore hydroelectric power has been supplied to San Francisco from the mountain power houses of the Pacific Gas & Electric Company solely via Mission San José and the San Mateo peninsula, a distance of 107 miles from the Cordelia substation to Martin station. As a double-circuit steel-tower line had already been constructed from Cordelia to San Rafael, the construction of 9.2 miles of tower line to Sausalito and the laying of a cable across the Golden Gate gave a second means of transmitting power from Cordelia to San Francisco over a route only 43.3 miles in length.

In May, 1915, it was finally decided to carry out the project. To accomplish this it was necessary—

First—To extend the 60,000 volt Cordelia-San Rafael steel tower line from San Rafael to Sausalito, and to erect at that point a step-down substation.

Second—to build a pole line 4500 ft. long from the substation across the government reservation on the Marin shore to the cable landing at Yellow Bluff.

Third—To lay two submarine cables across the Golden Gate, a distance of approximately 13,000 ft.

Fourth—To erect a cable terminal house on the Presidio shore in San Francisco and extend four underground cables to substation "F," a distance of approximately 6500 ft.

The installation was designed to deliver into San Francisco 18,000 h.p. of hydroelectric energy.

As the voltage of the San Francisco high tension distributing system was 11,000 volts, it was desired to make the cable installation 11,000 volts to conform with this. It was advisable and, incidentally, necessary to cross within the "forbidden anchorage" area between the Presidio shore, San Francisco, and the Fort Baker shore, Marin. This was selected as the best route, taking into consideration water conditions and shore landings, also it was the shortest distance between the high tension station on the Marin shore and substation "F" on the San Francisco side.

In considering the installation it was known that cable of the size required could not be made in one continuous length and that it would be necessary to make at least ten splices for each completed cable. How to relieve splice and joint of strain when laying was a most important problem. Experience had demonstrated that it was impossible to successfully lay a cable which had been spliced on shore and mounted on one reel, because the tension in the joints when laying invariably resulted in electric failure of the splice.

In making this installation, too, consideration had to be given to the six-knot tide which prevailed in this channel; to the depth of water, which exceeded 200 ft.; and to the possibility of ships' anchors fouling the cable in the event they had to drop anchor in the vicinity. The question of repairing the cable, should failure at any time occur, was also important, as the strain

on the cable itself when lifted from a 200 ft. bottom would be excessive.

It was, therefore, determined to use the messenger method of installation which had been developed and used successfully by A. J. Pahl of San Francisco. In this, first, a steel rope is laid from shore to shore and anchored securely at both ends. This, called the messenger, can be laid quickly when tide conditions are favorable and acts as a guide line for laying the power cable. When ready to lay the power cable the messenger cable is picked up at the shore end and laid



Map of Pacific Gas & Electric Co. Transmission Lines.

across the barge on which the reels carrying the power cable are mounted.

An ordinary cable grip, such as is used on street railway cable cars, is mounted on the barge. The messenger cable passes over sheaves and through the grip, which is operated by one man. At his will the messenger cable is allowed to slide through or be clamped by the grip; thus the operator absolutely controls the movement of the barge while it is being towed across the water by a launch. The messenger cable must be of sufficient size to withstand all of the strains imposed upon it. However, the power of the launch towing the barge must not be in excess of the holding power of the grip.

With the messenger laid over the barge the launch proceeds to tow, the man at the grip controlling the speed of laying. As the power cable is paid out it is attached to the messenger. After a length of cable has been laid the barge is anchored fast to the messenger, a splice made "at sea" and the towing proceeds. This operation is continued until the barge (which in this case held four reels of cable, approximately 5000 ft.) is empty. The free end of the cable is then sealed with

a special lead sealing-cap, all securely attached to the messenger and lowered overboard, the barge being towed to shore (under-running the messenger), to receive another load of cable. When ready to start laying again the messenger is picked up at the free shore end, laid across the barge and under-run until the free end of the cable comes up, when the splicing and laying is repeated as before. The messenger thus takes all the strain, relieving the cable and joints from all tension.

The Messenger and Anchors.

The messenger in this case was a 37-wire galvanized steel strand $1\frac{3}{8}$ in. diameter, in one continuous length of 14,000 ft., having a breaking strength of 90 tons, weighing approximately $4\frac{1}{2}$ lb. per ft., the total weight of each messenger on the reel being approximately 30 tons.

The landing at Yellow Bluff on the Marin shore was not ideal, as there is no beach and the bluff rises from the water's edge 120 ft. almost perpendicularly. Anchors for the messengers were located at the base of this bluff just above the water's edge, short heading tunnels being driven into the rock about 15 ft., in which tunnels the anchor sheaves were located, concrete being used to hold them in place and the whole structure being protected by means of a concrete enclosure. The two tunnels, one for each cable, were located about 100 ft. apart.

The anchorage on the San Francisco shore was constructed on a sandy beach about 100 ft. from the water's edge. The design of this, therefore, was somewhat different from the others, although the iron structure in all of the anchorages was the same.

The messenger was held in the anchorage by means of a series of three-bolt and single-bolt clamps and a mass of melted zinc was poured around in order to assist the clamps. The bridge socket type of anchor was not used, for the reason that it might be desirable to change the tension in the messenger at some later date. The anchorages were designed to withstand a tension equal to the maximum strength of the messengers.

The Power Cable.

The submarine cables were 3-conductor, 250,000 c. m. copper, each conductor having an insulation of $\frac{6}{32}$ in. 30 per cent Para rubber, over which was placed a $\frac{4}{64}$ in. layer of varnish cambric.

The three conductors were laid together in circular form (a jute filler being used), a $\frac{10}{64}$ in. varnish cambric belt being applied over all. The enclosing sheath was $\frac{5}{32}$ in. pure lead. Over the lead two layers of jute were applied, the total thickness of which was $\frac{4}{32}$ in. The jute formed a cushion for the steel wire armor, consisting of forty-two wires of No. 4 B. W. G. extra galvanized iron, and this armor was in turn covered with a layer of jute $\frac{4}{32}$ in. thick, to which was applied a sand and asphaltum finish for mechanical protection.

The shore ends were of the same specification as the main submarine cables, except that the conductors were 350,000 c. m.

Each cable contains a twisted pair of telephone wires, No. 13 B. & S. copper, insulated with varnish cambric $\frac{2}{32}$ in. thick, cotton braided and laid in the jute filler in the cable between the conductors and

under the outerbelt of varnish cambric. In order that no "ground" might be introduced into the cable the telephone wires were protected at both ends by means of telephone insulating transformers.

Testing Equipment.

In order that the cable might be tested as the work proceeded a testing station was erected in a temporary shed built on the Marin shore and a 2200 volt line extended from Sausalito to the cable landing. This station had a capacity of 200 kw. at 22,000 volts, a suitable water rheostat being provided for voltage regulation. Each length of cable laid was tested with a megger, and when three lengths were spliced they were subjected to a two-minute test from the testing station at a minimum pressure of 20,000 volts between conductors and between conductors and ground. When one complete cable had been laid it was subjected to a test pressure of 22,000 volts for $3\frac{1}{2}$ minutes between conductors and between conductors and ground.

Cable-Laying Equipment.

The barge used in cable-laying was of 125 tons capacity, being 70 ft. long by 30 ft. wide, and when loaded had a freeboard of approximately 5 ft. When laying the messenger the axis of the reel was parallel to the short axis of the barge, a 100 h.p. launch being used for towing.

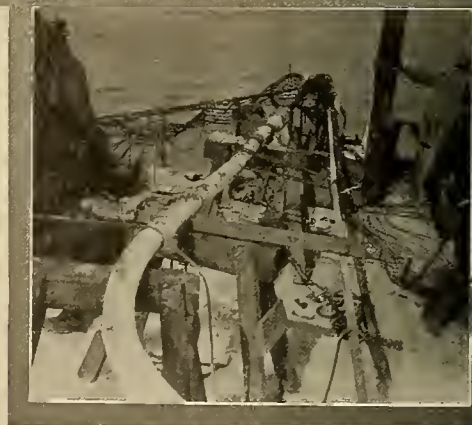
The same barge was used when laying cable, but the cable reels were mounted with their axes parallel to the long axis of the barge; in this way the barge was least affected by the prevailing action of the tide and waves in the channel. The tow for the cable-laying equipment was a 50 h.p. launch; during very heavy tide run two launches were necessary for towing the equipment.

When ready to lay cable the messenger was picked up at shore and laid across the barge. On both sides of the barge grooved cast iron sheaves, 40 in. in diameter, were securely fastened to the deck, a rigging being provided to prevent the messenger cable from leaving the sheave, no matter what position the barge might take. The cable was fed from the reels around spools through the serving machine, together with the messenger cable, the two being tied together by the machine in question.

The serving machine, driven by a gasoline engine, consisted of two circular iron rings mounted in an iron frame, the rings being made to revolve by means of a friction drive arranged so that the machine could be started or stopped by the movement of a handle. Removable jaws in the cast iron rings were provided so that the machine could be slipped over the cable and the messenger. Two spools of galvanized iron were held between the rings and near their outer edge. When the cable and messenger were allowed to travel through the serving machine the rings were made to revolve, and the machine would wind around the cable and the messenger a serving of two No. 6 galvanized iron wires. Every 20 ft. the movement of the barge was stopped by means of the grip and a considerable number of turns wound around the cable and the messenger at one point. This was done to secure the attachment of the cable to the messenger at least every 20 ft. in the event the serving wires should break between these wraps. Formerly the work of serving



Feeding Cable Around Rolls on Barge.



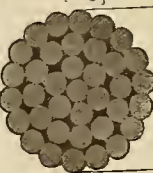
Splicing Operations on Barge.



Loading the Power Cable on the Barge.

- 4" Tanned jute
- 42- No. 4 B.W.G. Galv. armor wires.
- 4" Tanned jute
- 32" Lead
- 32" Varnished cloth belt
- Telephone pair = 2 No. 13 B.&S. 7 strand
- 4" Varnished cloth, cotton braid & paraffine.
- Jute filler (impregnated)
- 4" Varnished cloth.
- 12" Rubber, 30% Para.
- 250 000 c/m. (37 tinned strands)

SECTION OF
MESSENGER CABLE
2-14 000 FT. LENGTHS



37 No. 4 B.W.G.
galv. steel cable.
1/3" diameter



Section of 11,000 Volt Submarine Power Cable.

was done entirely by hand, a slow and tedious process; however, with the development of the serving machine for this installation the work was greatly facilitated and much better performed. The speed when laying cable was about 8 ft. per minute.

The Joint.

When a length of cable had been paid out the messenger was made fast in the grip on one side of the barge, and on the other side the messenger and the cable were lashed to the sheave. To make the joint mechanically strong it was necessary to lap the armor about 15 ft. In order to get sufficient armor to make this lap it was necessary to cut off about 15 ft. of cable from the end that projected out of the water. The armor was then folded back and held in place and

of approximately 460 degrees F. The size of the sleeve insured a belt of approximately one-half inch of compound around the joint between the insulation and the sleeve. The temperature at which the compound was poured served not only to fill every crevice but to vulcanize the rubber tapes on the conductor in such a way as to form a homogenous mass equal almost in quality to the original insulation.

The joint was sealed and burlap, dipped in hot insulating compound, applied over the splice, care being taken to fill the space at the point of wiping in order that there be no "humps" between the cable proper and the splice; any unevenness at this point made the replacing of armor and serving wires difficult.



Serving Machine Applying Band Wires over Splice.



Serving Machine and Completely Served Splice.

shape by means of holding rings; it being necessary to maintain the original shape of the armor to obtain a good fit when laying it back into final position.

The copper conductors were sweated together, four layers of pure rubber tape applied over each conductors and over this alternate layers of 40 per cent and 30 per cent Para rubber tape, until the insulation on each conductor was approximately 50 per cent greater than the original rubber insulation. Over the rubber tape seven layers of high-grade varnish cambric tape were applied.

The telephone conductors were then spliced, varnish cambric being used entirely for insulation. In order to lessen the induction in the telephone system the twisted pair was transposed at every joint, so that in the completed cable the telephone pair lay first between legs 1-2, then 2-3 and then 3-1.

Varnish cambric spacers were now inserted between the power conductors, and the whole joint made ready for the lead sleeve.

A single lead sleeve $4\frac{1}{2}$ in. inside diameter by $\frac{5}{16}$ in. thick and 24 in. long was wiped to the main sheath and the joint filled with ozite, poured at a temperature

The armor wires were then put back into place and the same serving machine again brought into action, except that the serving wires were now fed through slotted bars attached to one side of the circular revolving cast iron rings. As the barge was held fast to the messenger, the serving machine was mounted on rollers, and as the serving wires were laid over the joint the machine forced itself along. Every 12 in. the serving wires were soldered together to protect against the wire unwrapping for any distance in case it should break. Here again the serving machine accomplished in one hour the work that was formerly done in eight hours by hand.

After the joint had been served it was carefully paid overboard, every effort being used to protect it against any undue strains. The cable was not attached to the messenger for a distance of 8 ft. each side of the splice, thus allowing the splice freedom of movement independent of the messenger. With prevailing wind and tide conditions it required on an average of twenty-four hours to pay out one length and make a splice. There were eleven splices for each completed cable.

Laying the Last Length.

Cable-laying was continued in the manner described until within approximately 800 ft. from shore, at which point the cable was sealed, attached to the messenger and dropped overboard. The barge was then towed to shore and turned around, the messenger again picked up and the shore end pulled up on the beach. After the shore end was made fast cable-laying was resumed, the shore end being paid out until the end that was dropped overboard appeared, when the final splice was made. The cable and messenger were then under-run to a point midway between two splices, the two hoisted over the reels and then gradually lowered to the bottom by means of ropes. This method was pursued as it was the easiest way in which to handle the shore end. Furthermore, there was no difficulty in handling this because enough slack had been left near the shore to allow hoisting overboard as above described.

Laying of the power cable was commenced September 26th. The log of the work shows that "with the combined efforts of all the towing equipment, a large amount of block and tackle and hard work of ten men, it took one day to raise the shore end up the steep cliff at Yellow Bluff."

Laying and splicing proceeded in the manner described, save that "for three days heavy fogs covered the channel, limiting the view to a distance less than 1000 ft. and causing the men on the barge much uneasiness, as several large ocean-going liners passed very close to the barge." During the nights when these fogs prevailed the log shows that "the watchman broke two fog bells in his endeavor to warn all traffic that he was there." However, the first messenger cable was completed without accident, tested successfully and laid overboard on the afternoon of October 7th, twenty working days being required to make the installation of messenger and cable.

The work on the second cable was started October 16th and completed and tested on October 30th. Extremely heavy tide runs occasioned considerable trouble, the force of the tide being strong enough to cause the messenger to slip in the temporary anchors while the barge was near the center of the channel. This indicated that the force of the tide was strong enough to move the messenger cable, which between barge and shore amounted to a weight of twelve tons in addition

to friction of the cable on the sandy bottom and the holding power of the temporary clamps.

In the meantime work on the terminal house and the land cable connections was being rushed, and the tie-in between Substation "F" and the submarine cables was completed and voltage applied from the San Francisco system on November 5th, this completing the cable installation.

Tests.

Exceptional opportunities were available in this installation for determining heating tests on submarine cables and as little data has heretofore been published on the subject the following may be of interest:

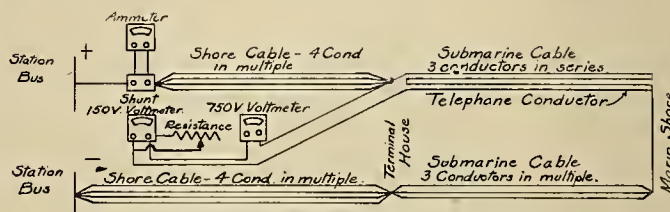
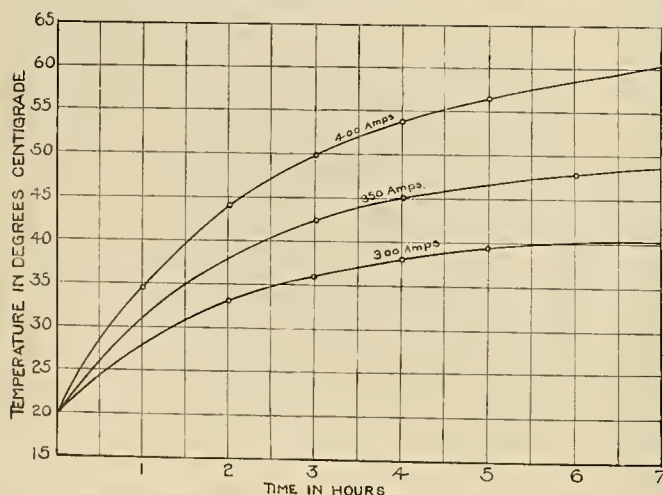


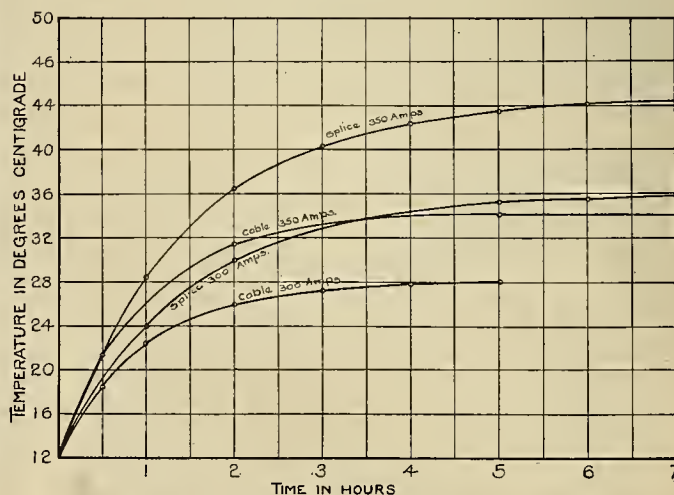
Diagram of Testing Connections.

Having available a 650 volt 1000 kw. direct current generator it was possible by connecting the cables in the manner shown in the accompanying sketch to circulate direct current through the conductors of the submarine cable. The telephone wires in the cable and on the shore ends were used as pressure wires. It was therefore possible to determine the voltage drop in the cable for any given load.

From the observations obtained the accompanying temperature curves were plotted. One shows the rise in temperature of the submarine cable for loads of 300 and 350 amperes, the temperature of the bay water being 12 degrees C. As each cable contained quite a few splices and as the insulation around the splice was much greater than the insulation around the cable tests were made in the laboratory on a splice under temperature conditions similar to that surrounding the splice in the water. The curve shows also the rise in temperature for the splice. It can therefore be seen that cables immersed in water of 12 degrees C. have a considerable higher carrying capacity than would normally be expected. These tests were conducted for a period of 12 hours, which was long enough for the temperature to become steady.



Temperature Rise of Submarine Cable and Splice.



Heat Rise of 350 m. Shore Ends in Air, with 20° C. Temperature of Surrounding Air.

The shore ends 350,000 c. m. are not entirely under water. It was therefore necessary to make the same tests on these cables. The other curve shows the temperature curves for the shore ends. As the life of the rubber insulation depends largely upon the temperature to which the rubber is subjected it can therefore be seen that the safe carrying capacity of the cables is approximately 350 amperes due largely to the radiating capacity of the splices and the shore ends, although under emergency conditions for very short periods of time the cables could safely carry as high as 490 amperes.

No previous mention has been made as to operation of the telephone line. Communication between substation "F" and the Marin substation is as perfect as could be desired.

It would be amiss at this time not to mention that the work of laying the cables was let by contract to A. J. Pahl, to whose experience and efforts much of the success of this work, was due. The construction of the anchorages and the terminal house was under the charge of H. G. Vensano. To Messrs. Jollyman, Thompson and those engineers of the company's staff who assisted in this difficult undertaking, the thanks of the writer are given.

Electric generating stations in China are confined to a few large cities. At Hong Kong the China Light & Power Company has installed 516 kw. capacity and will install 1500 kw. this year; the Victoria station contains 2000 kw. in Diesel engines, 600 kw. in steam engines and plans to install a new steam turbine unit; in the Taikoo dockyard d.c. generators having a capacity of 2250 kw. are driven by gas engines supplied from Mond gas producers, and in the Naval dockyard has a large central station with steam and Diesel engines. At Canton a 1540 kw. steam and Diesel engine plant has been installed. At Shanghai there are two 5000 kw. and two 2000 kw. turbines. An English firm have installed 102 steam engines in China, with a total rating of 28,960 b.h.p. Most of these are used for electricity supply. Another British firm have installed in North China at Soochow a 375 kw., 3-phase alternator, direct coupled to a high speed steam engine, complete with high tension switchboard, etc. In Chang Chow there is a 150 kw., 3-phase alternator, direct coupled to a high speed steam engine complete with water tube boilers, high tension switchboard, transformers, etc. In Tientsin there are two 75 kw. continuous current generators coupled to high speed steam engines, supplied for extension lighting of the Japanese settlement. Further contracts recently secured are for the lighting of two other large Chinese cities; the electrical plant consists of one 200 kw. and one 150 kw. 3-phase alternator. A large number of single-phase and 3-phase motors from 5 up to 100 h.p. have also been supplied for use in cotton mills and other factories. An outlet for electrical plant is found in up-country hospitals, missions, and private Chinese residences where small dynamos driven by oil engines are very much in favor. Many small steam engines and dynamos for lighting river steamers have been sent to South China, as well as small oil driven sets for hotels and private houses.

DIESEL ENGINE PRACTICE.

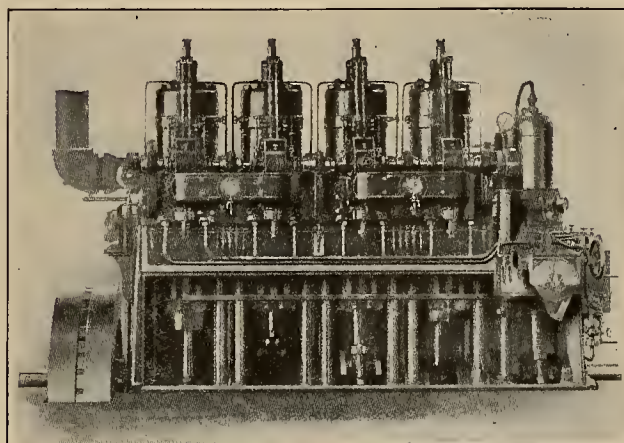
BY J. E. MEGSON AND H. S. JONES.

Diesel Engines Applied to Marine Purposes.

(Continued.)

The Southwark Foundry and Machine Co. are building the Southwark Harriss Valveless Engine. It is of the verticle two-cycle type operating on the full Diesel principle. This engine, though it is made for both stationary and marine application is used most extensively aboard ship.

In the marine engine a step piston is used, the lower portion of which acts as a scavenger air compressor and also for starting the engine. The starting air of relative low pressure, 175 lb. per in., is allowed to enter the lower cylinder, in this way avoiding the necessity of this cold aid entering the working cylinder and causing violent temperature changes. This lower piston also acts as a crosshead, taking the side thrust of the connecting rod. In manoeuvring a vessel the air cylinder is said to assist the working cylinder by using compressed air if it is desirable. The engine is reversible and as the engine operates on the two-stroke-cycle principle this is comparatively simple, due to the absence of valves. The engine is made two to



240 I. H. P. Southwark-Harris Valveless Engine, Diesel Principle, Marine Type.

eight cylinders from 120 to 2000 h.p. This engine is installed in many vessels on the Pacific Coast and many more on the Atlantic.

The Bolinder, a semi-Diesel engine, made in Sweden, has been successfully operated in a number of vessels in this country.

The Polar Diesel Engine Company of Stockholm, delivered the twin-screw two-cycle engines of about 800 h.p. each for the "Sebastian," built at Dundee, but they did not give satisfaction.

In May, 1914, the "Arum," with English-built Polar type engines made her trial. The engines are of the single-acting, two-cycle type. Each of the two engines has 4 cylinders, bore 16.2 in., stroke 3.9 in., speed 135 r.p.m., power rated at 650 b.h.p. each. The principal dimensions of the ship are 360 ft. by 47 ft. by 27 ft. depth, 22 ft. draft, carrying 550 tons. After performing various short trips, the "Arum" was sent on her first long voyage to the Persian Gulf, which was perfectly successful according to reports obtained.

The German motorship "Secundus" started her career likewise in 1914. The owner, Hamburg-

American line, now possesses two Diesel motor vessels, "Christian X" and "Secundus." The former has four-cycle Burmeister Wain engines, the latter has two-cycle engines built by Blohm & Voss of Hamburg. Each of these two engines has four cylinders of 23.6 in. bore, the stroke is 36.2 in., speed 120 r.p.m., power 1850 h.p. per engine.

The scavenging air is produced by a pump worked by levers off one of the cross heads. The air enters the cylinders through 4 poppet valves in each cylinder head.

The exhaust gases leave the cylinders through openings in the cylinder walls, and a water-cooled pipe. The lower part of the engine resembles a steam engine, but forced lubrication is employed; the crankshaft bearings are water cooled. The pistons are cooled with fresh water, which may be considered an unnecessary complication.

The "Secundus" made one complete voyage from Hamburg to New York and back. At the outbreak of the war she had not started her second voyage and is now therefore presumably at Hamburg.

The results obtained with a few non-reversible engines of 350 b.h.p., driving propellers with reversible blades promise a great future for such engines for medium size crafts. The reversing of the blades is performed with aid of the engine power. The advantage of this is the excellent security of manoeuvring, which is controlled directly from the bridge. The installation is of course far simpler than one with reversible engines. The manoeuvring air reservoirs are cut out and the auxiliaries are of a far simpler nature.

In designing a motor ship an important question is, how to drive the deck-machinery and the auxiliaries in the engine room. When plenty of money and good personnel is available, the best system is to generate electricity by Diesel engines and drive everything electrically. Where fuel to heat a boiler is expensive, this system is also the most economical in the long run. In first cost it is, however, the greatest, and a staff of engineers is required to undertake many novelties at once. To save first cost and to keep the novelties in the ship within the smallest limits, the best plan is to have two donkey boilers. Fire them either by coal or oil, depending on the price, and drive everything by steam, including the air compressor required to manoeuvre the main motor. When the ship runs several days continuously and the motor is four-cycle, the waste gases can heat the donkey boiler, giving plenty of steam for steering and for the whistle. The gain is about 1 ton of oil per day for ships of about 6000 tons. In short runs, or when the motor has to slow down often, this system cannot be applied. To drive the auxiliaries by compressed air has not proved a success; the air compressors must be too large. In tank ships it is good practice to make the main cargo-discharging pump centrifugal and drive it by a Diesel engine. The same engine can then drive the air compressor for manoeuvring. This system is slightly more expensive in first cost, but, when the ship has to unload often, it is cheaper in service than steam pumps. It also permits the ship to unload the cargo when it would be dangerous to fire a steam boiler.

The New London Ship & Engine Company, which started operation in 1910 have built a large number of the marine Diesel engines produced in the United States, a typical type is shown in section in Fig. 30. Although it has been in operation only a comparatively short time, its record to date is as follows:

Engines built and building	107
No. of cylinders, approximately.....	600
Total horsepower, approximately.....	40,000
Smallest engine	60 h.p.
Largest engine	1,000 h.p.

Their efforts have been directed largely toward engines for sub-marines. The engines being applied to merchant service are of the four-stroke-cycle type with the cam shaft on both sides of the cylinder for the operation of the admission and exhaust valve, the fuel valve being vertical in the center of the head.

There has always been a difference between the European and American point of view, due to conditions. It may be stated, in general terms, that, in Europe, capital was scarce, consequently, the European shipowner considered ultimate saving, and was willing to pay a greater first cost for his

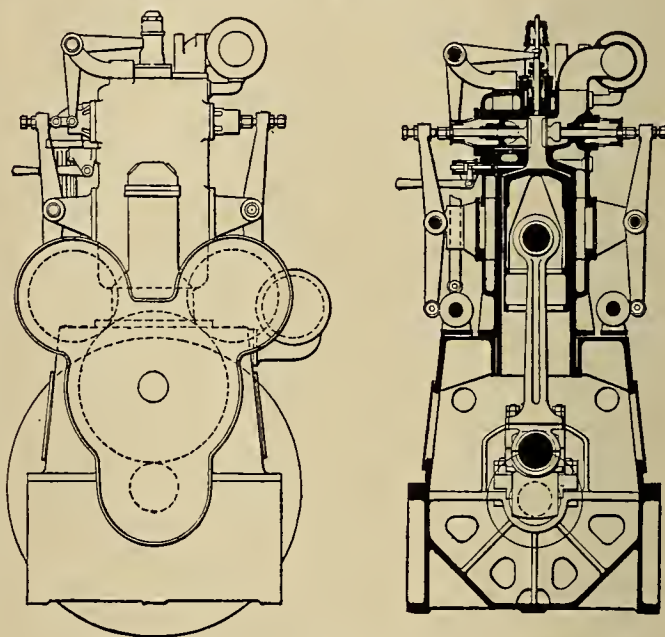


Fig. 30. New London Ship & Engine Co. Engine.

propelling plant, if the operating economy would show on ultimate gain. In the United States, the shipping business has never been given much encouragement, and those who have gone into the business have had to seriously consider first cost. Furthermore, both coal and oil are comparatively cheap in this country. Finally, information in regard to Diesel engines has been obtained principally from the technical description of foreign vessels. It is only comparatively recently that Diesel-engined ships have visited American ports, so that first-hand information from actual observation has been scarce. A further drawback to American development has been the lack of trained operators. In the course of time, the basic advantages will be realized in the United States and the necessary trained operators will be developed.

Many ships intended for trade between the Atlantic and Pacific Coast, through the Panama Canal, are being fitted with to burn oil under their boilers. To

one acquainted with the operation of a Diesel engine, this seems to be almost a wicked waste. The same amount of the same fuel used in a Diesel engine would run four ships instead of one, or would carry one ship four times as far.

Probably the two-cycle motor will eventually become cheaper to manufacture than the four-cycle for the same power. The running economy of the four-stroke-cycle is the greater, especially when the waste gases are passed through a steam donkey-boiler.

The cost to make a good marine engine is, and will remain probably, about $1/3$ higher than to make a good reciprocating steam-engine and boilers of the same power, but this higher price is partly compensated by the cheaper ship, because the Diesel engine takes up less room and weight than the steam installations, as the boilers are omitted and the bunkers can be made much smaller. This latter saving depends on the distance or intervals between the places where it is economical to replenish the bunkers.

The large motor ship requires fewer men to run than the large steamship; the quality of the men must, however, be higher. Difficulties with the troublesome firemen are eliminated; but the motor ship if not well attended to, is apt to require more repair in harbor than the steamship.

Balancing these good and bad qualities of motors and steamships, the fuel price in the parts of the world where the ship has to run will generally decide to which the balance will incline. In special cases, however, the fuel price will not be the main factor to be considered, but the following properties of the motor-driven ship are of greater value: That it does not require any warming up of boilers or engines, even if nobody has been on board in advance, the motor ship can start at full speed as soon as the oil tanks are filled. That it is possible for a motor ship to bunker only at very long intervals, three or four times longer than a steamship. And last, but not least, that motor ships can be made in which the part of the ship where the engines are placed is of absolutely the same temperature as the other parts of the ship. In hot climates this quality will go far to turn the balance when the engineers have a say in the decision.

Probably the worst enemies of the marine Diesel engine, during the past ten years, have been the over-enthusiastic advocates. Many have made promises they could not fulfill. Others have built and installed engines which were experiments. New firms are continually entering the field, little realizing that the design and construction of these engines are highly developed specialties. The first engines produced in this way are generally failures; and, unfortunately the good and the bad suffer as a result. The experienced builders approach perfection only by close application, and naturally do not publish all of the practical points which they develop in the course of their work.

The Diesel engine as applied to merchant ships to the present time has proved that this engine, if well designed, well made and well attended to, is reliable enough for the longest voyages and is at least four times more economical in fuel consumption, weight for weight, than a coal-fired steamship, or nearly 3 times more economical than an oil-fired vessel.

THE ELECTRICAL MACHINERY SALESMAN.

BY F. D. WEBER.

An electrical machinery salesman should be a man of honor and high ideals, with a broad enough view of the industry and life to see beyond the order he may be trying to get for equipment. He should have a personal interest in getting every engineering detail of an installation in first class shape and use his influence by showing the purchaser that this means money in his pocket. It is also generally possible for him to show that the first cost of an installation made in a proper manner will be no greater than one done in a slovenly and dangerous way.

By doing this missionary work he will place his equipment in a more favorable position to give satisfaction. When the electrical salesman is not broad-minded, and can not see beyond the order for his particular equipment, his influence is extremely detrimental. Many times he intentionally makes "capital" of the other features of the installation, his method being to tell the prospective customer, "give me your order and we will do all your engineering and you can hire men yourself to actually install the equipment and we will superintend it." Generally, this proposition sounds alluring to the customer who is placing his first order for electrical machinery, especially as it comes direct from the salesman representing a company of high standing as a manufacturer, it means, that unless the salesman's company actually places its engineers at work on the specifications and drawings and conscientiously tries to make a first class installation, the salesman is apt to forget his promise in his haste for other orders and no drawings or specifications are prepared, and at the last minute he attempts to make a few pencil sketches and does a lot of loud talking about how simple the work is and how anyone ought to know how to do such a simple thing and for the customer to go right ahead and there will be no trouble. By this time the customer has employed his men who have the qualifications of good "bo-hunks" for his electricians. They may speak English and many times they can't. Then the troubles start. Generally, with some inspection department, either municipal or underwriters', or both. The customer is furious and rushes to the salesman and tells him his troubles. The salesman immediately tells him that all inspection is a "farce" and that he knows that what he is doing is all O.K. and that he will see that particular inspection department and show them a thing or two. After the salesman has interviewed the inspection department and has told them that this specific work has been passed from "coast to coast," without convincing anyone except himself, he will return to the owner and tell him "I guess we had better get some one who knows how this work should be done."

From the many cases of this kind that have come to the public attention in the last few years, it would appear that the legitimate procedure for a salesman of electrical apparatus would be to confine his efforts to his own line of apparatus and not try to influence his customer into a course which for the time being appeals to "the pocket-book," but which nearly always leads to disaster.

REPORT ON COLUMBIA RIVER POWER PROJECT.

BY L. F. HARZA.

Appendix I—Estimate of Capital Cost and Annual Cost of Power.

In what follows, the capital cost and annual cost of generating power have been estimated upon two assumed plans of development: first, that power of a sufficient amount to pay operating expenses, interest, depreciation and all other necessary charges, is under contract when the station commences operation; and second, that the development of the station load takes place gradually and at uniform rate during the first ten years of station operation.

In the first case the capital cost includes the estimated actual physical cost, plus a margin of 25 per cent for engineering, administration and contingencies, and another margin to cover interest during construction on the full physical cost for one-half of the assumed construction period of five years. The annual expense of generating power includes items for current maintenance and repairs, station attendance, administration, depreciation and interest upon capital investment. Interest has been assumed both at 3 per cent and 4 per cent based upon public construction of the project, and at 6 per cent on securities originally sold at a discount of 10 per cent with 1 per cent added for taxes to represent the cost under corporate financing. To the cost of power thus estimated a margin of 25 per cent has been added in each case for contingencies and profit, the result indicating the minimum practicable price at which power could be sold with a margin of profit probably too small to be considered at this time other than a liberal contingent allowance.

In the second case, or the one based upon a ten-year period for building up the station load, it is assumed that the generating machinery be installed progressively as the load builds up and that this equipment would cost 25 per cent extra because of purchase in this manner. In addition to the item of capital cost previously considered the deficits of the earlier years are allowed to accumulate and add to the capital cost upon which the station must pay returns after becoming a going concern at the end of the ten years. The stated prices of power allow a margin of 25 per cent after the first ten years for contingencies and profit as in the former case.

Two groups of power values are stated—one based upon the sale of only the primary capacity, 480,000 horsepower, and the other upon the sale of the surplus power at 80 per cent of the price of primary power for eleven months' service, 60 per cent for ten months' service, and 30 per cent for eight months' service.

The amount of storage for serving a variable load is small, and power would need to be sold either on the basis of peak demand or at a price per unit of average consumption which would net the stated amount per horsepower of peak demand with due consideration for the load factor of the customer. Thus in the case of a customer having a load factor of 50 per cent, such as approximately experienced by the large electric service companies serving mixed loads in this territory, the actual cost of energy would be twice the stated cost of power per horsepower of peak load, while for electro-chemical industries with high load factor the increase, if any, would be small.

It must be remembered that the following figures represent estimated cost of generation, the 25 per cent margin which has been added not being sufficient to serve as a profit if the project were undertaken as a profit making venture, but rather to insure against losses due to incorrect prediction of cost of generation or to accidental losses. There would also always be the possibility of business failure on the part of a customer, in which case contracts could not be enforced and losses would be suffered by the generating company. If the construction of the project were undertaken without prior contracts for power, then the period required to build up the load would be entirely conjectural, and the ten years' assumption adopted for the following table is meant to be illustrative only. Because of the risk assumed in case of construction under this plan, the early contracts would need to provide a much larger margin of profit than shown.

It will be seen from the following tables that a company such as the local distribution companies, serving a mixed load at a load factor of about 50 per cent, would need to pay a price for power of about \$30 to \$37 per h.p. year of average consumption, or 0.46 to 0.57 cents per kw.-hr., if the proposed power project were constructed upon the usual basis of corporate finance. These prices are comparable with the costs of generation in existing corporation-owned stations of smaller sizes. They represent merely the costs of generation under the assumed conditions, and include nothing for transformation, transmission or distribution of power, which expenses, if the power is transmitted far, add very greatly to the ultimate cost to large consumers and constitute the major proportion of the cost of serving small consumers. The apparently low prices of power in the following tables thus result from the cases based upon public construction at low rates of interest, and upon the use of the power at a high load factor of 80 or 90 per cent as in the case of the chemical industries, the power being purchased and used in the immediate vicinity of the generating station and at generated voltage.

Table showing annual cost of primary power upon various assumptions if entire load were sold when generating station is ready to operate.*

	Interest Rate	Only Primary load of 480,000 h.p. sold		Entire load of 800,000 h.p. sold at relative prices previously stated	
		Dollars per h.p. year	Cents per kw. hour	Dollars per h.p. year	Cents per kw. hour
Price based upon charge for peak demand or on readiness to serve basis.	3% 4% 6% on discounted bonds	9.02 10.34 15.13	..... ..... .....	6.63 7.58 11.02	...............
Equivalent charge for average demand at 50% load factor.	3% 4% 6% on discounted bonds	18.04 20.68 30.26	0.275 0.316 0.462	13.26 15.16 22.04	0.202 0.231 0.337
Equivalent charge for average demand at 80% load factor.	3% 4% 6% on discounted bonds	11.28 12.92 18.90	0.712 0.197 0.289	8.29 9.48 13.80	0.128 0.145 0.211
Electro-chemical service.					
Equivalent charge for average demand at 90% load factor. Electro-chemical service.....	3% 4% 6% on discounted bonds	10.01 11.49 16.81	0.153 0.175 0.257	7.37 8.42 12.25	0.113 0.129 0.187

*These summary tables are introduced prior to the estimates upon which they are based, for the benefit of any not interested in reading the detailed analyses, which appear later in this chapter.

Total estimated capital cost including interest during construction, \$50,000,000 (assumed the same for all rates of interest).

Table showing annual cost of power upon various assumptions if only one-tenth of the power is sold when the station is ready to operate and the sales thereafter increase uniformly until the entire load is sold at the end of the first ten years.

	Interest Rate	Only Primary load of 480,000 h.p. sold		Entire load of 800,000 h.p. sold at relative prices previously stated	
		Dollars per h.p. year	Cents per kw. hour	Dollars per h.p. per kw. year	Cents per kw. hour
Price based upon charge for peak demand on re a d i n e s s to serve basis.	3%	9.85	.....	7.25	.....
	4%	11.65	.....	8.55	.....
	6% on discounted bonds	18.75	.....	13.70	.....
Equivalent charge for average demand at 50% load factor.	3%	19.70	0.301	14.50	0.222
	4%	23.30	0.356	17.10	0.261
	6% on discounted bonds	37.50	0.573	27.40	0.418
Equivalent charge for average demand at 80% load factor.	3%	12.31	0.188	9.06	0.138
	4%	14.57	0.222	10.70	0.163
	6% on discounted bonds	23.42	0.358	17.12	0.261
Equivalent charge for average demand at 90% load factor.	3%	10.95	0.167	8.05	0.123
	4%	12.95	0.198	9.50	0.145
	6% on discounted bonds	20.85	0.318	15.22	0.233

Under the assumptions used in computing the latter table the physical investment, including interest only during construction, would vary from about \$52,000,000 for 3 per cent interest to \$55,000,000 for 6 per cent interest, while the total capital investment at the end of the ten-year development period, including the accumulated deficits, would be as follows:

With 3% interest	\$61,000,000
With 4% interest	63,000,000
With 6% interest and with securities sold at a discount of 10% the actual cash investment would be	70,000,000
and the face value of bonded debt.....	78,000,000

As previously stated, exhaustive studies as to the relative economy of several alternative schemes of development have not been possible under this investigation. It was deemed to be more important to carry through a complete analysis of some one general scheme which appeared at the outset to be the most economical and to apply a large part of the available time and means to the solution of these general problems upon which the feasibility or practicability of the project depends. This procedure introduces an element of safety into the estimates to the extent that the development of improved plans in line with possibilities that have been indicated as the work proceeded, but which have not been studied in detail, will tend to greater economy.

The well known and almost universal tendency of engineering estimates to be exceeded in actual construction has been guarded against in several ways to the greatest extent which appears to be warranted.

In nearly all cases where a choice is possible between two schemes the more expensive has been chosen as the basis for estimates, unless the conditions indicate that its ultimate adoption is very improbable.

In the choice between the Camere and Tainter gate types of control dams the latter have been chosen at a cost of \$8,837,000 as compared with \$3,851,000, the estimated cost of the Camere type. Both figures as given represent the approximate cost based upon a controlled depth of 67 ft. instead of a depth of 81 ft.

for which they were actually designed, and are in each case 75 per cent of the cost as estimated in detail for the greater depth. As discussed in Appendix G, the data which justifies this reduction in depth became available too late to permit redesign and re-estimate of cost by more than approximate computations from which the cost ratio of 75 per cent was deduced.

In the case of the power house location, three choices are possible, as shown on Fig. 7 and as discussed in Appendix H. Project A involves the unwatering of the deep bay of Big Eddy; Project B avoids this at an expense of 580,000 yards in rock excavation, while Project C extends the power house upstream rather than into the gully to the north of Big Eddy, and in doing so eliminates about 379,000 yards of excavation, which, together with other items, saves about \$885,000 over Project A. Project A is thus intermediate in cost, but has been adopted for the estimate in the belief that it is as expensive a layout as need be anticipated.

The estimates which have been made for the several schemes of concrete closing dam indicate that it could be built, if built at all, for a cost very little above that of the rockfill dam, and that an actual saving would be effected when the consequent reduction in rock excavation for the shallower flood channel is considered. The estimate as used therefore provides for the most expensive type under consideration.

If a floodway should be built entirely across the river, including the space occupied by the present channel, as has been proposed in case a concrete dam is used, such approximate computations as have been possible in the time available indicate that the piers and gates would not cost more than for the deeper and shorter floodway used with the loose fill dam. The estimate as made will therefore provide for any type of controlling works which has been proposed.

Preliminary quotations have been asked from the manufacturers of the required mechanical equipment. In doing so they were requested to name a figure which would be a safe outside estimate applicable during good business conditions rather than during the present general depression. In all cases the maximum quotation either of competing companies or on alternative schemes from the same company was used.

Unit prices. Cost estimates have been made up from unit prices believed to be ample.

The nearest past approach to the problem of excavation which would be here encountered was in the case of the Chicago Drainage Canal. The costs varied in that case from 38.3 cents to 56.5 cents per cubic yard, as given by Gillette, not including, however, the cost of drill-sharpening and plant interest and depreciation. The several portions of the excavation for this project have been segregated according to ease of disposal, and have been given base prices varying generally from 80 cents to one dollar per yard, except in the case of the removal of the natural rock cofferdam at the power house site, where a price of \$1.75 has been used. Rock excavation in the power canal has been placed at 80 cents per yard, as its location is well suited to rapid loading on adjacent tracks by overhead bridge or traveling cableway. Rock excavation for the flood channel has been placed at 90 cents per yard, and for the diversion channel at \$1

per yard, because of less convenient locations for disposal. It has been found that, by filling up the valley on the Washington side at the damsite to elevation 180, together with the use of rock for rock fill dam, raising of railroads, for concrete, etc., the entire excavation can be disposed of with a haul not exceeding about one mile except for that used in raising of the railroads. The amount of required rock excavation is so large as to warrant the development and installation of special equipment for economical handling, and the unit prices anticipate the use of such equipment.

The handling of loose rock above the cost of excavation already given has been placed at 60 cents for filling cribs, 50 cents for raising on to rock pile for Scheme A of closing dam (see Fig. 30-A), 50 cents for loose fill on closing dam of any type after diversion of river, 75 cents for loose fill in Scheme B prior to diversion, \$1 per yard for a blanket of crushed stone 10 ft. thick on upper face of a rockfill dam, 50 cents per yard for earth and sand blanket, \$2 per yard for riprap paving 2 ft. thick.

The unit prices have been varied from \$70 per ton for reinforcing steel to \$80 and \$90 per ton for structural steel, depending chiefly upon the differences in cost of falsework, field riveting, and other erection items. These prices are sufficient to cover rail transportation from the east, although water transportation through the Panama Canal is now quoted at about \$6 per ton less than the rail rate. The items for the most expensive work are as follows: base, f.o.b. Pittsburg, \$35; freight, \$18; fabrication, \$15; erection, \$15; design overhead and insurance, etc., \$7; total, \$90. Steel for the roller dams, patent for which is controlled in Germany, has been estimated at \$140 per ton, including operating machinery, this figure being based upon known selling prices. Cast steel has been estimated at 8 cents per pound for the large conical pedestals in the tainter gate bearings and other castings of similar size. For small castings where many are required 10 cents per pound has been used.

The price of plain concrete has been varied from a minimum of \$5 per yard for massive work to a maximum of \$12 per yard, exclusive of steel, where walls are thin and forming expensive. In most cases steel reinforcement has been estimated separately, but where not the unit cost of the concrete has been increased by an amount depending upon the percentage of steel required, the unit cost per yard including steel amounting in some cases to as much as \$18.

In the work on the Dalles-Celilo canal the U. S. Engineers have screened the tailings from their rock crusher, gaining thereby about one-half enough sand for concrete and have obtained the other half from a sandbar about one-half mile above the dam site. There is an ample supply of similar sand and gravel in bars not far from the work and in a small valley on the Washington side immediately adjacent to the dam site. It is believed that the assumed prices for concrete are ample, considering the large amount required and the massive nature of the structures.

Timber in booms has been estimated at \$22 per M. exclusive of hardware, and in cribs at \$30 per M. The

former would require no cutting or fitting, the labor being that only of handling and drift-bolting.

The power house superstructure has been estimated upon the basis of walls four feet thick at \$16 per cubic yard and roof at 50 cents per square foot. The resulting price per cubic foot is 6½ cents, which compares favorably with costs recorded for other similar buildings when the fact is considered that the floor and foundations have already been included in the cost of the substructure.

Temporary rubble masonry with very lean mortar and minimum hand work for retaining walls in Scheme A, Figure 30, has been estimated at \$2.50 per yard, and permanent rubble for exterior slopes of canal wall at \$3.50 per yard. The chain bags for Scheme D are estimated to cost 7 cents per pound, and the chain manufactured on the concrete arch, for Scheme B, 9 cents per pound.

The total estimated cost of railroad regrading to the profiles shown in Fig. 5 has been based upon a unit price of 40 cents per yard. In reality most of this material would be spoil from the excavation, and train service would be the only extra charge required, the cost for which would be much less than indicated. Some gravel and sand would be borrowed from nearby bars or dunes, and used to fill under the ties during raising of the track. The price assumed is sufficient to permit all material to be borrowed in this relatively expensive manner.

The entire estimated values of all agricultural and other lands, fishwheels, power site at the mouth of the Des Chutes River, land required for proposed development, and all other private properties in any manner affected, have been multiplied by three in arriving at the general property damage.

(To be continued.)

Flow of water in irrigation channels is discussed in a paper to be presented by G. H. Ellis before the American Society of Civil Engineers on March 15, 1916. He deduces the general formula $V = C R^{0.63} S^{0.5}$, where V is the velocity in feet per second, C is a coefficient depending upon the roughness of the channel, R is the mean hydraulic radius and S the slope. For concrete channels C is 105, for wood 100, and for earth 60.

The break in the Seattle pipe line supplying water, in the opinion of R. H. Ober, who was engaged to investigate the trouble, was not occasioned by the decay of the wood staves of which the pipe is constructed, nor by reason of the fact that the pipe was constructed of wood instead of some other material. The formation of a vacuum as a result of the freezing of the standpipes would have caused the collapse of a steel pipe or of a reinforced concrete pipe as surely as of the wood stave pipe, and the repairs that would have been necessary in the case of the steel or reinforced concrete pipe would have required a much longer time and larger expense than in the case of the wood stave pipe. It is believed that the injury to the pipe lines and the consequent interruption of the water supply of Seattle were due to lack of care in the construction of the standpipes and to failure to prevent the water in these standpipes from freezing.

"WIRE YOUR HOME" MONTH.

BY JOHN A RANDOLPH.

A few weeks ago the leading advertising men of the electrical industry met in the offices of the Society for Electrical Development at New York to formulate plans for a novel trade movement soon to be conducted by the united electrical interests. It is known as "Wire Your Home" month and will be held from March 15th to April 15th.

Heretofore, many of the central stations, manufacturers and other electrical interests have conducted disconnected spring wiring campaigns. There has always been lacking that scope and momentum which comes from a common effort in which individual activities of this nature are amalgamated in one big drive with all the interests enthusiastically working shoulder-to-shoulder to achieve the common cause. It has therefore been wisely considered by the electrical men that with the entire industry acting as a unit, during "Wire Your Home" month, in extending electric current to the homes of the country that are now without it, much better results can be obtained than through individual efforts.

One of the reasons why such a campaign is timely is that not 8 per cent of the homes of this country are wired for electricity. The best figures available show that not 20 per cent of those houses adjacent to central station lines are wired. One statistician places the number of these unwired houses in the United States convenient to electric service at 1,900,000.

With the prestige of electricity now established on a nation-wide footing, with its practicability for industrial, domestic and commercial pursuits proved to the satisfaction of the most skeptical, arguments to induce people to adopt electric service should hardly be necessary. The majority of people are well aware of the advantages of electricity, but the inertia of indifference and the "satisfied-as-it-is" attitude acts as an obstacle in the path of conversion to the "Do It Electrically" doctrine. It takes an impulse to arouse in the face of such indifference sufficient interest in things electrical to lead to the adoption of electrical service. Another deterring factor is the trouble of getting bids; the multiplicity of detail involved in determining just what is wanted, in going over the details with perhaps, several contractors and coming to a decision and closing the matter. Then, many people have been misled into believing that the cost of installing will prove burdensome. With others, the false impression exists that wiring the house will necessitate extensive tearing up of floors, considerable breaking away of walls with consequent dirt and litter. They argue that they do not wish to undergo such annoyance.

In a successful house wiring campaign these deterring factors must be met. The householder must be stimulated from a passive into an active desire for electric service. Definite concrete offers must be presented for selection. These must be of such a nature and of such costs as to meet the probable needs of the majority of prospects. Finally, the cost factor must be met by arranging terms of easy payment that will suit the means of the prospects and lift the burden of a considerable cash outlay from their shoulders.

The coming campaign aims by a concerted, shoulder-to-shoulder movement of the central stations, electrical manufacturers, contractors and other electrical interests to afford any easy, simple and economical means of solving these problems together with offering special inducements that cannot fail, in many instances, to secure contracts.

To properly launch the campaign the Society has sent broadcast to the central stations, manufacturers, dealers, jobbers and contractors of the country 25,000 copies of an announcement setting forth the object and nature of the movement with an appeal to all electrical interests to join in the campaign. Following the announcement, they issued 25,000 copies of a 28 page booklet entitled "Successful House Wiring Plans" which contains a large number of campaign plans which have been tried in various parts of the country with highly successful results. To give further prominence to the movement, the Society will issue a special news sheet to be known as the "Electrifier" which will be similar to the "Exciter" distributed during "Electrical Prosperity Week." The Society is issuing to its members a special service of window display suggestions. It is also handling the general publicity in the trade press and newspapers, including its electrical page service to the newspapers.

The manufacturers are co-operating actively in the movement by distributing a large amount of special campaign matter, conducting extensive advertising, supplying cuts, and mats for use in local newspapers, and in furnishing assistance to their dealers in various other ways. They are sending out 10,000 copies of an unusually attractive window display, to the central stations, jobbers and contractors. It consists mainly of a trim made up of circular transparencies arranged for attaching to the glass of the window. Each transparency contains, in colors, a view of a room in a modern home, equipped with the electrical appliances commonly used in that part of the house. Each view is connected by a tape to a view at the rear of the window box representing a hand in the act of closing an electric button switch. A header or caption mounted on the window pane above the display calls attention to the campaign. The display carries a strong appeal which is at once apparent. It cannot fail to bring prospects into the store or display room wherever it is used.

This generous co-operation on the part of the manufacturers is highly important inasmuch as nearly every central station, contractor, jobber and dealer in the country has a contract with some one of the lamp companies.

It is the aim of the organized interests in the "Wire Your Home" campaign to awaken enthusiasm in the industry itself, to the end that special efforts may be made to extend everywhere complete electric service. It is rightly judged that the spring is the ideal time for such a campaign. With the combined efforts of lamp and affiliated manufacturers, together with local central stations, jobbers, contractors and dealers, conducting a concentrated campaign through the offices of the Society for Electrical Development, thousands of homes are sure to be wired with consequent benefits to all.

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Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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Some months ago, in commenting upon the activities of the Federal Trade Commission, the statement was made in these columns that "it is as yet too early to prophesy what will be the result of the commission's close range study of the various problems which it is called upon to meet. Without doubt however the business men of the country will become better acquainted with the laws under which their businesses must be conducted." This statement is more than borne out in the notable address by Edward N. Hurley, vice-chairman of the commission, before the electrical jobbers at Detroit and as read at Del Monte.

After speaking of the benefits of co-operation he makes a strong plea for better accounting methods and business practice. He shows that a manufacturer who does not know his cost of production, a jobber who does not know his cost of selling, or a contractor who does not know his cost of construction "is not in a position to intelligently meet competition and invites business disaster." He commends the association for its zeal in trying to help the contractor to become a better merchant. He said:

"It is a fact well understood among business men that the general demoralization in a large number of industries has been caused by firms which cut prices, not knowing what their goods actually cost to manufacture, and which almost wholly lose sight of the cost of selling, which is equally important. Are the officers of the companies who are cutting prices right and left, irrespective of their costs, fair to their customers, stockholders or competitors?"

This accurate knowledge of costs should be accompanied by an improvement in methods, changes in design and standardization of processes and products. With such forms of constructive criticism it appears that this new commission can justify its existence and earn a permanent place among the country's economic institutions.

Although the capitalization of good will, like that of franchise values, is not favored by public service commissions, each is an indispensable element in the successful conduct of a public utility. While the need for a franchise is self-evident, the necessity for public good will is not always fully appreciated. It is sometimes thought that the will of the people, whether good or ill, makes little difference in the amount of the utility consumed. This was the original doctrine of quasi-public service corporations. The service was looked upon as a monopoly-controlled necessity.

Today the situation is different. There is not only competition between public utility companies but also between different kinds of service, as is exemplified by jitney competition with the electric railway, wireless competition with the telegraph, or electric competition with gas. Patronage depends upon the quality of the service rendered and the good will of the public served. Furthermore good will is a vital factor in the rate situation and is an effective deadener of agitation for municipal operation of public utilities.

Thus it is seen that while good will is not a tangible asset it is none the less essential to the success of a public utility. A man seldom attempts to place a cash value on his friends, yet they may contribute indirectly to his success. Likewise with a public utility, for good will is friendship, just as clearly as ill will is enmity.

The greatest problem now facing the public utility industry is the betterment of public relations. The engineering problems are well in hand, the financial difficulties are understood, but the human questions are unsolved. And it is upon the solution of the human question that the fate of the public utilities of this country now depends.

The importance of this point has, perhaps, been more fully realized by the electric railway men than by any other branch of the industry. They have adopted an admirable code of principles as the corner stone of the edifice of better human relations which they are erecting. Recognizing that the real and enduring friendship of the people can be cemented only by confidence, they are endeavoring to win it through frank and honest dealings in all details of corporation affairs. Finally the structure is being reared by the aid of aggressive advertising to teach the public that the best interests of the community and the company can be served by a partnership relation, and that the quality of the service which the company is able to give the public depends largely upon the sale of its bonds, which in turn is affected by the community opinion of the company.

Much that has been written about this subject is banal and fails to reach the root of the trouble. That the thought of the most of the people has lagged behind the great change in economic conditions during the past fifty years may be partly due to the inertia of the educational systems. Though more than half our population is now urban in character, the methods of education are still largely those employed when the rural element predominated. As a consequence most people do not seem to comprehend the new responsibilities which have come with new privileges.

As President Wilbur of Stanford University suggested in a speech before the Commonwealth Club of San Francisco last week, American universities, in particular, are not democratic enough. The same criticism is made by those conducting school surveys. There is a tendency toward an intellectual aristocracy without giving proper opportunity to the great majority to receive either vocational training or a proper appreciation of the best qualifications for leaders.

It is therefore comparatively easy for those who seek political preferment to become the leaders in American politics, while the abilities of more capable men are overlooked. There is as great need for intelligent followership as for wise leadership. With more attention paid to moral efficiency, with a higher standard of right and wrong and a more enlightened selection of leaders many of the present abuses of our civic life would be eliminated.

This is the groundwork which public service officials should lay. The trend of education should be to obviate envy and to emphasize the common welfare. In proportion as this is encouraged by public utilities,

will they be able to correct the evils by which they are now threatened.

It is only by improving the present ideals, or rather lack of ideals, that it will be possible to eliminate the antagonism between those who have and those who have not. A broader conception of human relationship on the part of those engaged in the public service is the only antidote to the poison of ill will which is being insidiously introduced into the body politic.

Men will be governed precisely as they deserve and desire. By teaching them to be more deserving and by raising the standards of their desires is the logical way to bring about good government.

Concretely expressed, this means that the manager of the public service company should take an intimate and personal interest in the affairs of the community. In this way he may learn to correct all those corporation practices which are detrimental to the common weal and earn the confidence of those he would serve. In perfecting the physical equipment of his system, he should not neglect the human nature side of his business. The same thought applies with equal force to each and every employe, for to some consumer or group of consumers he personifies the company.

In the manufacture of lighting fixtures those who strive to realize their ideals are so often disappointed by that quick-change artist,—the lamp manufacturer,—or, through the misapprehension of a buying public uninformed as to what is best, that it is not surprising to find a carelessness creeping into this branch of the electrical business. This gives ground for the fear that the fixture field may be captured by those who merely have something to sell and no other object in view than to sell it.

Among those fixtures which fall far short of the "realizable ideal" are several makes of self-contained lighting units. These are so named because, though of the indirect or semi-indirect class, they are provided with their own secondary light-giving area and so do not depend upon reflection from the ceiling and walls.

Certain sections are suffering from a plethora of these fixtures through an all too successful selling campaign together with the advent at its launching, of the introduction of the Type C Mazda lamp. That fixtures of this kind contain great possibilities, even making these desirable classes of illumination suitable in heretofore impossible situations, goes without question but it is a pity to find uninstructed or dishonest specialty salesmen attributing the increased lamp efficiency to these self-contained and often inefficient lighting fixtures.

For the fixture manufacturer designing these units, for it is everyone's field, the foregoing comments are of value. These fixtures should be made practical and as far as possible scientifically correct both in themselves and their installation. In this way the electrical trade can win back this business from the hardware dealer and the outside jobber and by aggressive selling and advertising aid in keeping electric lighting in the premier place it should occupy as an illuminant.

Self-Contained Lighting Units

PERSONALS

F. N. Averill, manager of the Fobes Supply Company, has returned to Portland from San Francisco.

Harry Byrne, general manager of the North Coast Electric Company, has returned to Seattle from a trip to California.

F. H. Murray, representative of the National Carbon Company of Los Angeles, was at San Francisco the first part of the week.

H. B. Squires, manufacturers' agent, recently returned to San Francisco from a business trip throughout the southern part of the state.

H. S. Whiting, vice-president of Pierson-Roeding Company, San Francisco, spent a few days in Los Angeles the latter part of the week.

Guy Rose of the Moore Rose Company, electrical contractors and dealers of Healdsburg, Cal., was a recent business visitor at San Francisco.

H. H. Hughes, representative of the Westinghouse Electric & Manufacturing Company at Fresno, Cal., was a recent business visitor at San Francisco.

C. R. Hunt, Pacific Coast manager of the Robbins-Myers Company, left the latter part of last week for an extended business trip to Seattle and the Northwest.

E. A. West, newly-appointed chief engineer for the Denver Tramway Company, is on his way to assume his new duties via Los Angeles and Salt Lake City.

E. M. Cutting, Pacific Coast manager of the Edison Storage Battery Supply Company, has left San Francisco via Portland and Seattle to visit the Eastern factory.

T. W. Simpson, Pacific Coast manager of the Federal Sign System (Electric) has left for a business trip throughout the Northwest and expects to be gone about ten days.

Geo. S. Quinan has been appointed engineer for the Seattle division of the Puget Sound Traction, Light & Power Company, **S. C. Lindsay** being electrical engineer of the division.

H. W. Turner, president of the Washington Electric Supply Company and **H. L. Bargion**, general manager, have returned to Spokane after attending the jobbers' meeting at Del Monte, Cal.

Quinton Adams has recently joined the sales force of the Westinghouse Electric & Manufacturing Company at San Francisco, having been transferred from the New York office of the company.

Thos. Finigan, Pacific Coast manager of the American Brake Shoe & Foundry Company, left last week to attend the electric railway convention in New York. He expects to return in about ten days.

F. Van Vleck, formerly connected with the Bristol Company's exhibit at the Panama-Pacific International Exposition, has recently left San Francisco for Waterbury, Connecticut, to do some special work in the Bristol Company's laboratories.

E. Doherty, representative of the American Electric Heating company of Chicago, Ill., is a recent visitor on the coast. **E. G. McBrearty**, who was formerly their representative, has opened up an office of his own in the real estate business in Detroit.

E. H. Le Tournean has been promoted from the position of assistant engineer to efficiency engineer of the Portland Railway, Light & Power Company, taking the place of **E. A. West**, who resigned to become chief engineer of the Denver Tramways.

A. S. Armstrong, representing R. J. Davis, agent for Century single phase motors and fans, has returned from a trip through the Sacramento Valley. **Paul A. Shilton**, Southern California manager for R. J. Davis, has been visiting the Imperial Valley during last week.

MEETING NOTICES.

Portland A. I. E. E. and N. E. L. A. Sections.

The tenth bi-weekly luncheon of the joint sections of the A. I. E. E. and the N. E. L. A. was held at the Chamber of Commerce, Portland, Oregon, at noon, March 2d. Mr. A. S. Moody acted as chairman. The speaker of the day was Robert G. Diecks, commissioner of public works of the city of Portland, Oregon. His subject was the "Causes of Slides in Portland and Reasons for Same." Mr. Fuller, vice-president of the Portland Railway, Light & Power Company, gave a lengthy discussion of the subject from his personal experience.

Jovian League of Los Angeles.

A liberal education in mythology was received by those attending the luncheon Wednesday, March 1st in the discourse delivered by Seward A. Simons, entitled "By Jove." Mr. Simons is a brilliant orator, and a recognized authority on mythology, and his semi-humorous dissertation on the Roman deities of the days of legend, was very interesting and entertaining to every one present. Giving due credit to the gods for their prowess and skill, he declared that these splendid apparitions of the past had nothing on the present day deities of the electrical industry. He presented facts and figures showing their feats to be insignificant beside the remarkable wonders now being wrought with the very element that gave them fame,—electricity. This is the last of a series of talks given before the league by various speakers, on the subject of "Jove." President Holland presided, and Fred C. Moon of the Otis Elevator Company was chairman of the day.

San Francisco Electrical Development and Jovian League.

The March 1st luncheon, of which N. J. Pendergast, division advertising agent of the Pacific Telephone & Telegraph Company, was chairman, was one of the most instructive and interesting of the current year. Before President E. M. Cutting turned the meeting over to Chairman Pendergast a band of Hawaiian musicians entertained the members with songs and music. Dr. William T. Bawden, specialist in industrial education for the U. S. Educational Bureau, was then introduced and explained the purpose and methods of the school survey now being conducted in San Francisco, the first city to be thus studied, though a number of state educational systems has been similarly investigated. As a result of this survey, definite recommendations for improvement will be made by the twelve experts who have been conducting it. Dr. Bawden also spoke on the recent progress in vocational training, an effort to make education more democratic. His thought, that the schools, besides being concerned, as at present, primarily with education for wise leadership, should also provide education for intelligent followership, was ably seconded by Dr. John W. Withers, president of the teachers' association of St. Louis. Dr. Withers showed that although the past century has brought about a tremendous change in the customs of our people, a corresponding change has not been made in our educational system. While the present age knows how to make wealth, it does not know how to use and appreciate it. He spoke of the necessity of educating the rank and file to an appreciation of the best qualities of a leader. He argued for municipal as well as state universities in meeting this need. The remarks of both speakers were heartily applauded and a rising vote of thanks extended to them at the close of the meeting.

TRADE NOTES.

C. F. Braun & Company, consulting mechanical engineers, 503 Market street, San Francisco, have made arrangements to manufacture locally feed water and service heaters; water purifying apparatus, including filters, softeners, and sterilizers; feed water grease extractors; expansion joints, anchors and guides; cooling towers; water debris strainers; and steam separators and exhaust heads.

ELECTRICAL JOBBERS AT DEL MONTE.

"Two score and ten" electrical men spent four days' time and unmentioned money at Del Monte, March 1-5, learning how to play the game ethically,—golf as well as electrical. Notwithstanding prevalent Scotch mists the enthusiasm was not dampened nor was the Scotch missed. Thursday and Friday, by means of the Darwinian theory, the twelve jobbers and twelve manufacturers best fitted were selected to compete in the match play on Saturday morning, when the jobbers persisted in starting to play in the rain—with disastrous results to themselves, as the following results show:

Team Play for Manufacturers' Cup.

Jobbers—		Manufacturers—	
Hillis		Sanderson	
Turner	1	Gregory	
Holabird		Murray	
Hall	2	Oakes	
Carter, H. V.		Davis	
Low		Poss	3
Carter, C. H.		Lillard	
Leggett		Bibbins	3
Goodwin		Young	
Burger	3	Seaver	
Colwell		Holberton	
Hartley		Squires	3
	6		9

All this fun had its serious side which culminated in a get together meeting of jobbers, manufacturers and central stations on Saturday afternoon. First consideration was given to a paper by Edward N. Hurley, vice-chairman of the Industrial Trade Commission, telling of the need for better business methods and commending such organizations as the Electrical Supply Jobbers' Association, which, "if conducted in a spirit of mutual helpfulness, with the machinery of the government standing by subject to call, will help solve pressing problems and remove many of the present handicaps of business." The paper was read by Secretary Albert H. Elliott.

In the subsequent discussion Geo. C. Holberton emphasized the need for practicing as well as preaching co-operation. He suggested co-operative advertising by manufacturers and dealers, as the results of individual advertising brought only 20 per cent returns to the individual, while bringing 80 per cent returns to others.

W. W. Low gave an interesting talk and read a noteworthy paper on "Co-operation" based on confidence, loyalty and honesty. It is hoped to publish this paper in its entirety. It concludes with a suggested creed for jobbers, whereby they can continue to do business ethically.

Lee Newbert and Stanley Walton spoke briefly of the results of the co-operative sales campaign being carried on by the jobbers and the Pacific Gas & Electric Company. It is possible that definite results of the campaign will be available for the next meeting. A sales policy for handling electric ranges will be determined soon and Mr. Walton urged that a co-operative advertising campaign be started by the manufacturers. He also suggested that some plan be devised whereby a liberal allowance might be made to the consumer for old electrical devices which were replaced by newer models.

Ira J. Francis brought out the point that better results would be obtained from co-operative sales campaigns if the contractor-dealer were given specific assurance of profit instead of generalities and vague expectations. Benj. Scranton and T. E. Bibbins briefly explained the heating element situation, after which the meeting was brought to a close with a vote of thanks to Mr. Holberton of the Pacific Gas & Electric Company for showing moving pictures of the Golden Gate cable crossing.

Announcement of the cup winners was made at the golf-dinner on Saturday night, when Geo. C. Holberton presided as toastmaster. The jobbers' copper cup was presented to W. W. Low by R. D. Holabird with appropriate recital of its

historical associations. The goddess of chance was called to decide the tie for the manufacturers' cup between T. E. Bibbins and F. H. Poss, Poss winning the toss. The Pass & Seymour cup was presented to C. C. Hillis by W. H. Seaver, the central station cup to Geo. Holberton by Ira Francis and the manufacturers' cup for match play to Garnett Young by F. H. Leggett. The dinner was brought to an end with a stirring address on loyalty and confidence by A. H. Elliott.

The following were in attendance:

R. M. Alvord, General Electric Co., San Francisco.
 F. N. Averill, Fobes Supply Co., Portland.
 H. L. Bargion, Washington Electric Supply Co., Spokane.
 R. F. Behan, Westinghouse Elect. & Mfg. Co., San Francisco.
 T. E. Bibbins, General Electric Co., San Francisco.
 T. E. Burger and wife, Western Electric Co., Los Angeles.
 Harry Byrne, North Coast Electric Co., Seattle.
 C. H. Carter, Pacific States Electric Co., Los Angeles.
 H. V. Carter, Pacific States Electric Co., San Francisco.
 J. I. Colwell, Western Electric Co., Seattle.
 R. J. Davis, Century Electric Co., San Francisco.
 C. P. Deming, National India Rubber Co., Seattle.
 E. Doherty, American Electric Heater Co., Detroit.
 A. H. Elliot, Electrical Supply Jobbers' Assn., San Francisco.
 Frank Fagan, General Electric Co., San Francisco.
 I. J. Francis, John A. Roebing's Sons Co., Los Angeles.
 W. L. Goodwin, Pacific States Electric Co., San Francisco.
 N. W. Graham, Holabird-Reynolds Electric Co., Los Angeles.
 S. B. Gregory, Arrow Electric Co., San Francisco.
 C. B. Hall, Illinois Electric Co., Los Angeles.
 A. H. Halloran, Journal of Electricity, Power and Gas.
 C. C. Hillis, Electric Appliance Co., San Francisco.
 G. C. Holberton, Pacific Gas & Electric Co., San Francisco.
 R. D. Holabird, Holabird-Reynolds Co., San Francisco.
 H. H. Hoxie, Elec. Railway & Mfrs. Supply Co., San Francisco.
 W. H. Kerrigan, Journal of Electricity, Power & Gas.
 C. D. La Moree, Westinghouse Elec. & Mfg. Co., Los Angeles.
 F. H. Leggett and wife, Western Electric Co., San Francisco.
 O. W. Lillard and wife, Gould Storage Bat. Co., San Francisco.
 W. W. Low and wife, Electric Appliance Co., Chicago.
 F. H. Murray, National Carbon Co., Los Angeles.
 R. W. Murphy, Westinghouse Lamp Co., Los Angeles.
 Lee Newbert, Pacific Gas & Electric Co., San Francisco.
 R. F. Oakes, American Ever Ready Co., San Francisco.
 James G. Pomeroy, Manufacturers' Agent, Los Angeles.
 F. H. Poss, Benjamin Electric Mfg. Co., San Francisco.
 Frank Quinn, Manhattan Electric Supply Co., San Francisco.
 H. E. Sanderson, Bryant Electric Co., San Francisco.
 W. H. Seaver, U. S. Steel Products Co., San Francisco.
 B. F. Scranton and wife, American Electric Heater Co., Detroit.
 H. E. Squires, Manufacturers' Agent, San Francisco.
 H. W. Turner, Washington Electric Supply Co., Spokane.
 J. A. Vandegrift, National Lamp Works, Oakland.
 S. V. Walton and wife, Pacific Gas & Electric Co., San Francisco.
 C. E. Wiggin, Dunham-Carrigan & Hayden, San Francisco.
 W. C. Wurfel, Westinghouse Lamp Co., San Francisco.
 Garnett Young, Telephone & Electric Equip. Co., San Francisco.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The commission has authorized the Western States Gas & Electric Company to withdraw from the Girard Trust Company \$9365.87 spent for betterments to the gas company's plant.

The commission has authorized the Roseville Telephone Company, Placer County, to issue \$1670 worth of stock to reimburse its treasury for money expended.

The Midland Counties Public Service Corporation has applied to the commission for authority to renew promissory notes for \$79,849.55 to the First National Bank of Coalinga, United States Aluminum Company, Western Electric Company and other corporations for not over one year, and at not over 7 per cent.

W. F. Whitter has applied to the commission for authority to sell his plant at Hemet, Riverside County, to the Southern Sierras Power Company. The price fixed is \$4278.

The San Diego Consolidated Gas Company, San Diego County, has applied to the commission for authority to increase its capital stock from \$3,500,000 to \$6,000,000 and to issue and sell \$500,000 worth of preferred stock.

The commission has issued an order authorizing the Alturas Electric Power Company, of Modoc County, to issue \$90,000 of first mortgage 30-year 6 per cent bonds, and to execute a deed of trust to its property to secure a bonded indebtedness of \$100,000.

WASHINGTON CONTRACTORS ORGANIZE.

As was recently announced in these columns, the organization of the Washington Association of Electrical Contractors and Dealers has been perfected. The constitution and by-laws is practically the same as that of the Oregon association, as was printed in these columns last week. William H. Byers, of the NePage-McKenny Company has been chosen president; A. M. Jones, of the J. A. Roehling Sons, vice-president; Roy Worth, of the Pacific States Electric Company, secretary-treasurer.

The following code of principles has been adopted as the basis of action, being practically the same as the California and Oregon code:

Principles Which a Joint Committee of Contractors and Jobbers Advocate, with Outline of the Work Which the Joint Committee Proposes to Do.

It is a recognized fact that certain branches of the electrical industry are today in a very demoralized condition. As this is due largely to lack of proper co-operative effort on the part of the different branches of the industry, it is the belief of the committee that, with a proper organization whose primary interest is to educate its members to a greater responsibility, much good can be done in the way of properly serving the consumer and of creating a desire on his part to use electrical appliances and to adopt the idea, "Do it electrically," the slogan of "The Society for Electrical Development."

As examples of what can be accomplished we only have to review the work of improvement clubs, societies, chambers of commerce and similar organizations throughout the country. Could individuals in the same period of time have brought about the reforms and changes in business methods that these associations have accomplished for their membership? The Panama-Pacific Exposition, opened in San Francisco in 1915, is an evidence of co-operative association team work.

The central stations, through their strong organization, the National Electric Light Association, have brought the lighting and power industry to a high degree of development and, while doing so, have reduced rates to the consumer—neither of which could possibly have been accomplished through individual effort.

Electrical engineers, through the American Institute of Electrical Engineers, have been better prepared for their work through fuller knowledge of the requirements to be met and of the means of fulfilling them. This Institute is conducted purely for educational purposes and without individual profit to its members, except insofar as they improve themselves by participating in the work.

Electrical manufacturers and jobbers through co-operative work have done much toward educating themselves and as a result have placed their business on a firmer, more economical and more satisfactory basis. It has been proved through this work that, notwithstanding the increased cost of living and the consequent increase in the cost of almost every known commodity, the cost of electrical appliances has been steadily reduced and the quality of the article steadily improved. The principal effort on the part of these industries has been toward educating their members to the necessity of efficiency in order that the various branches may operate their particular business at a minimum of expense.

Architects have the American Institute of Architects as their National Association. We would hardly recognize as progressive an architect who is not a member of this Institute.

Some of this most valuable information is obtained through such membership and through his affiliation with other architects in association work.

While undoubtedly electrical products have made more rapid strides in the last ten years than any other industry, the building industry, generally, has kept apace with the times.

It is the belief of the committee, however, and it will be admitted by architects generally, that, while satisfactory progress has been made in the building industry, at least from an architectural standpoint, the electrical equipment in buildings of all classes has been steadily neglected, and it is common practice today, among many architects, to use electrical specifications which have been regarded by the electrical industry for a long time past as obsolete.

The occupant of any commercial type of building, hotel, apartment house, flat, bungalow, or private home generally realizes only too late that no provision has been made for the many electrical conveniences. Many attempts have been made on the part of electrical people to assist architects in the drawing of proper specifications but they invariably receive no encouragement as certain architects really believe that they have forgotten more about proper electrical installations than all the electrical men in the country ever knew and for this one reason they are impossible to approach.

They make no distinction between the reputable and the irresponsible electrical contractor. Their one idea seems to be to let the electrical contract simply on price. The result is evident.

Original cost of installation.....	100 per cent
Extra before occupancy of building..	25 per cent
Extra after building is complete....	50 per cent

and the installation is still incomplete. An additional allowance, in the first place, would undoubtedly have provided a better installation with less cost to the owner.

Electrical contractors have their national and state associations which have done much to educate their members in the proper conduct of their business and through their local meetings and state conventions have made possible an exchange of ideas that has tended to elevate the standard of work.

Notwithstanding the great results that have been accomplished by the association, there are many electrical contractors who have failed to recognize the advantages to be gained by such association effort. This is evidenced by the present state of the electrical contracting business.

In the past, when a contractor has been approached and the suggestion offered that he become a member of the association, he has immediately asked, "What am I to gain by joining it?" The answer to this question is that he gets out in proportion to what he puts in. Having put in nothing in the past, nothing is what he has gotten out.

It is the belief of the committee that an electrical contractor unattached is unable to keep apace with the progress of the industry and, consequently, is unable to properly serve his customers.

If he will become a member of the association and will give it his support, it would be impossible to estimate the benefits he will derive from it, as evidenced by the results of association work in other lines of endeavor, whether commercial or political.

As we have shown above that a competent architect should of necessity be a member of the American Institute of Architects or in some way affiliate with its local chapters, so it is clear that an electrical contractor should for the same reasons be a member of some association which represents his craft.

It is fully recognized that the economic and proper channel of distribution of electrical supplies is through the electrical supply jobber to the dealer and contractor, who, in turn, serves the consumer. By this method the dealer and contractor is enabled to have the advantage of a complete stock of electrical merchandise in the warehouse of the jobber which can be drawn on at any time, no matter whether it is one item or a hundred, and can be assured of prompt shipments and satisfactory service from every standpoint.

The jobber makes it his business to keep in close personal contact with the dealer and contractor in his territory, studies his wants and plans to serve his needs, no matter what they may be. Through frequent calls of his salesmen he is often enabled to give valuable information, keeping him advised of the new lines of standard goods on the market and furnishing technical data or give such other information as may be useful from time to time.

He is frequently able to be of service by carrying his contractor or dealer, who has been tied up financially on account of delays in jobs over which he has had no control.

This kind of service can not be had where the contractors and dealers do business at long range with people who are not in close touch or sympathy with their conditions or problems.

The dealer and contractor is the natural channel for distributing various electrical devices to the consuming public. He carries the material in stock and displays it on his counters and in his show windows. The consumer is thus enabled to see the material which he is purchasing and knows that he is getting full value for his money. He can get promptly any information he needs or instructions in the use of the various electrical devices which is a service that could not be rendered satisfactorily by correspondence with some distant point.

The object of this joint committee is to promote the use of electrical appliances and to influence the public to adopt the idea: "Do it electrically."

The co-operation of the central station in each district is highly desirable and a closer relationship with the architect and those engaged in the industry must be maintained. In the past, the industry has failed to provide suitable show rooms at which the consumer can obtain electrical appliances, therefore we will encourage the establishing of proper stores where material can be obtained at retail.

To accomplish this end, a campaign of education is about to be instituted. It provides for visits by the committee to all parts of the state, where public lectures will be given, supplemented by moving pictures, stereopticon views and working demonstrations of electrical appliances.

In order to gain the full confidence of the public in the industry we represent, the class of material furnished and the excellence of workmanship in its installation must be of the highest order. We should never recommend for sale an article in which we have not absolute confidence, and a full knowledge of the functions it will be called upon to perform.

We should not consider an installation as tending to promote the best interests of the industry, unless it has met with the unqualified conviction on the part of the contractor that it is of the highest class. An installation made by an electrical contractor, simply because it will pass inspection is undoubtedly bad practice.

We recognize that, in our business, probably more than in any other, the public is woefully ignorant of the quality and merits of electrical devices. Whether or not they are satisfied depends upon how we serve them. We should recognize that the National Electric Code, while having accomplished a great good, does not to the fullest extent accomplish the desired results for the reason that it does not distinguish between standards of material.

We will advocate the grading of material by the National Fire Protection Association.

We recognize that local inspection bureaus are not responsible for installations in compliance with architects' specifications.

We will advocate the employment of one or more competent electrical engineers, whose duty it will be to furnish architects with certificates, certifying that work has been performed in accordance with the specifications embodied in the contract.

Work may be performed which in every respect meets

the requirements not only of the National Fire Protection Association, but local, state and municipal inspection bureaus, which is not a credit to the electrical industry. We are opposed to electrical contractors, who, after executing a contract, endeavor to substitute material of lower grade. We advocate that the various electrical contractors' associations should assume the responsibility for seeing that their members perform work in accordance with specifications without attempting to evade their contract in any detail.

We believe that with proper co-operation on the part of the architect and other allied interests, the various state associations of electrical contractors will ultimately be able to guarantee on behalf of their members the completion of any contract entered into.

We will ascertain the names of all societies of architects, times and places of meeting, and will endeavor to have representative electrical engineers as well as members of our joint committee appear before these associations to explain the necessity of not only the proper drawing of, but also the compliance with recognized modern specifications.

Caution should constantly be exercised to see that only those contractors are admitted to membership of an association whose character and honesty are unquestioned and who have an established reputation for square dealing.

PORTLAND ELECTRICAL CONTRACTS.

M. J. Walsh & Company have rewired a portion of the Chicago Market at 187 Third street.

E. L. Knight & Company have been doing some rewiring for G. W. Gordon & Sons at 9 Third street.

W. C. Wight is installing the new electric lighting system for the Eastern & Western Lumber Company.

Scott Electric Company has wired the Western Fluff Rug Company's place of business at 54 Union street.

Skeen Electric Company are installing the motors at the Clark & Wilson Lumber Company's plant near Linnton.

Pierce-Tomilson Electric Company are doing some remodeling work for the Corbett Estate at 80 Front street.

Miller & Halls have just completed an electrical installation for the Brownsville Woolen Mills at 165 Third street.

I. B. Sturges has the contract for the wiring in the apartment house being constructed at Broadway and Clay streets.

Canderlip & Lord have the contract for the new White Company garage being built at W. Park and Couch streets.

Skeen Electric Company is rewiring the lighting system for the Pacific Bridge Company at their plant on E. Water street.

The Diamond Flour Mill Company at The Dalles, Oregon, is being electrified, the work being done by the owners.

E. S. Knight & Company have been installing an electrical system for the Portland Seed Company at 135 E. Second street.

Smith McCoy Electric Company have the electric contract for the new motion picture theater being installed in the Alisby Building.

R. E. Davis is rewiring the plant of the Electric Steel Foundry Company at 808 York street, which was recently destroyed by fire.

Grand Electric Company have the contract for wiring the new building being constructed for the Mutual Creamery, 26 E. Tenth street North, also Multnomah Camp Hall, 106 E. Sixth street.

The Bend Water, Light & Power Company are installing approximately 350 h.p. in induction motors to operate the new planing mill being constructed by the Brooks-Scandon Lumber Company at Bend, Oregon.

Morrison Electric Company have done the remodeling work in connection with the Failing Estate Building at 140 Fifth street. They also have the contract for the new Glafke warehouse on the East Side of the river.



NEWS NOTES



ILLUMINATION.

RIVERSIDE, CAL.—The board of public utilities has let the contract for furnishing incandescent lamps to the city for the ensuing year to the Westinghouse Electric Company.

FULLERTON, CAL.—The board of trustees has accepted a new lighting contract with the Southern California Edison Company which provides all night service and increased candle power lights.

MARSHFIELD, ORE.—Fire damaged the electric plant of the Oregon Power Company at North Bend on March 2 to the extent of about \$5000. Coos bay cities were in darkness for 30 minutes, until the auxiliary plant could be connected up.

RENO, NEV.—Plans for the installation of a modern system of electrolier lighting have been agreed upon by the city officials, who have been working on the matter in conjunction with the Reno Power, Light & Water Company. The total cost will not be more than \$5000.

MARTINEZ, CAL.—At the annual meeting of the stockholders of the Contra Costa Gas Company, directors were elected as follows: S. Waldo Coleman, John C. Coleman, Louis Glass, Ambrose Gherini and L. W. Prior. The directors organized by electing S. Waldo Coleman, president and general manager; Louis Glass, vice-president; and L. W. Prior, secretary and treasurer.

SPOKANE, WASH.—The Spokane Building Owners & Managers' Association has gone on record as favoring the erection of a lighting system on Riverside west of Washington street. An investigation of the cost of the system and a report on the adoption of ornamental electroliers is being prepared by a special committee consisting of C. E. Mallette, W. J. Kommero and Victor Dessert.

ANAHEIM, CAL.—A contract has been signed with the Southern California Edison Company to take electricity for lighting and power purposes in this city. The rate made was 1 1-3 cents per kilowatt hour for first 25,000, and 1 cent per kilowatt for all in excess of that amount. The minimum amount to be used each month is 31,666 kilowatts at a cost of \$400 per month delivered at the municipal power plant.

ROSEBURG, ORE.—A. Welch, formerly interested in the Douglas County Water & Light Company, of this city, has sold his stock to John Kiernan, a Portland capitalist. The transfer of Mr. Welch's interests to Mr. Kiernan also included half of the stock in the Seaside Light & Power Company. The local company is capitalized at \$600,000. The new officers of the company are: William Pollman of Baker, president; J. B. Yeon of Portland, vice-president, and John Kiernan, director and half owner. It is understood that extensive improvements will be undertaken.

TRANSMISSION.

LOS ANGELES, CAL.—It has been announced that the harbor commission soon proposes to take up with the power bureau the question of having transmission line for aqueduct power extended to the harbor district.

MYRTLE CREEK, ORE.—The town council has voted to employ Germond & Frear of Roseburg to make a survey and give estimates of the probable cost of installing a power project in the South Umpqua River near the mouth of Myrtle Creek.

OKANOGAN, WASH.—A plan is on foot by land owners along the river between Okanogan and Malott to secure the establishment of a small plant that will furnish the farmers with electricity. A committee consisting of S. G. Duley, T. F. Foster and Chas. Rumbolz has been named to investigate.

TROY, MONT.—The power site and water right of the company owning the Lake Creek Falls power project is reported sold to Lee Greenough and associates controlling the Banner and Bangle mines south of town. The power will be used to run the proposed electric line to the mines and other equipment of the company.

LOS ANGELES, CAL.—The public service commission has adopted three resolutions providing that proper officials shall make application to the U. S. Department of Agriculture for preliminary power rights, including rights of way for reservoirs, conduits, dam sites, etc., on Big Pine Creek, Cottonwood Creek, and Owens River Gorge.

TRANSPORTATION.

ONTARIO, CAL.—A Pacific Electric loop which has long been considered a possibility, is now being discussed as a probability. This line would touch the cities of Ontario, Upland, Claremont, Pomona and Chino.

NEEDLES, CAL.—It is stated that Peter McFarlane of El Paso is discussing the matter of a bridge across Colorado River at Oatman. He promises to build an electric railroad from here to Oatman within a year if he can be assured of a bridge across the river.

SALT LAKE, UTAH.—Application for a franchise to construct an electric railway from Tenth South street on Twenty-first E. street through Holliday, up Big Cottonwood to Brighton and to the mines in the forks of the canyons has been made by Le Grand Young.

KLAMATH FALLS, ORE.—Residents of the Malin section, 35 miles south of this city have taken up the matter of securing an electric railway from Malin to Klamath Falls, and they are now asking Klamath Falls to help in the matter. The farmers near Malin are willing to furnish the right of way and do the necessary grading for the road, providing Poe Valley and Klamath Basin will do the same.

OAKLAND, CAL.—A movement to open Twenty-second street through the Moffitt estate property from Broadway to Lake Shore avenue will be started by property owners in a short time, following the removal of the old residence and stables now being wrecked. This is the first step in the projected extension of the Key system's Twenty-second street line to Piedmont.

TELEPHONE AND TELEGRAPH.

CALAVERAS, CAL.—Application for permission to erect a telephone line over the county roads has been made by A. Guttinger.

OTHELLO, WASH.—O. G. Vroman has asked a permit of the city council to erect poles and install a telephone system in the town.

ETTERSBURG, CAL.—Arrangements are being made for the construction of a telephone line from Ettersburg and vicinity to connect with the Briceland line.

NAMPA, IDAHO.—The Mountain States Telephone & Telegraph Company is preparing to extend its service northeast from Bowmont to Kuna. The construction work will cost about \$5000.

HERMOSA BEACH, CAL.—Upon application of the Pacific Telephone & Telegraph Company for a franchise here, sealed bids will be received for the sale of said franchise up to April 18th.

PATTERSON, CAL.—The First Farmers' telephone line for Patterson was organized at a recent meeting. Rollie Peters was elected president and E. R. Leedy, secretary-treasurer. Steps for the construction of the line will be taken immediately.

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STREET LIGHTING.

BY CHARLES T. PHILLIPS.

INCREASING LOAD FACTOR IN ORDER TO DECREASE DETERIORATION OF ELECTRICAL APPARATUS.

BY F. G. BAUM.

REPORT ON COLUMBIA RIVER POWER PROJECT.

BY L. F. HARZA.

ELECTRIC IRRIGATION PUMPING IN IDAHO.

BY W. T. WALLACE.

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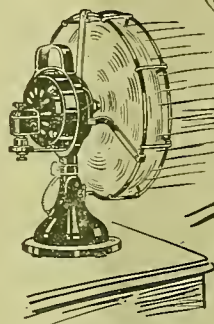
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STREET LIGHTING

BY CHARLES T. PHILLIPS.

(General consideration is here given to the several factors which combine to give satisfactory street illumination. The article should be of value to city officials or citizens interested in comparing different systems. The author is consulting engineer at San Francisco.—The Editor.)

The general subject of street lighting is such a broad one that it is impossible to cover all details without employing voluminous space. It is proposed, therefore, to consider only the fundamental principles without analyzing the details. The problem to be solved by the illuminating engineer is to produce the intensity required, with a consideration of the psycho-

by specular reflection; the hours of lighting are long; the installation cost is high; there is great liability of damage to the installation; the maintenance is high and there is excessive loss from dirt and dust. The intensity of light need not be high, providing it is fairly uniform. The load is one desired by the power company, due to the fact that most of the energy is



Road Illumination from Luminous Arc Lamps Equipped with Prismatic Refractors.

logical effect, at a minimum cost. This cost includes all expenditures for energy, maintenance, depreciation, interest and amortization fund; not only for the lamps but for all auxiliary equipment. Our present methods of obtaining artificial light are very crude, our most efficient illuminant having an efficiency of only about 6 per cent. Therefore the value of scrutinizing every item so as to bring the efficiency to as high a degree as possible is obvious.

Street lighting presents many more difficulties than interior lighting. The area is great and consists of long, narrow strips, very little assistance is rendered

taken "off the peak." These two factors are the only ones in favor of a street lighting installation when compared with interior lighting.

The lighting should be considered under at least five headings, each having several sub-divisions: streets devoted to retail trade where business is done to a large extent at night; streets in the wholesale and manufacturing district; residence streets; parks and boulevards, and thinly settled districts.

Street lighting equipment is frequently selected on the plea that it is giving satisfaction elsewhere. This method has lead to more unsatisfactory installa-

tions than it has satisfactory ones. In the first place how is it known that the installation "elsewhere" is giving good results? It is true that the streets may be well lighted, but at what cost? Was the installation carefully planned? Perhaps some other system would have been much more efficient and reliable than the one installed. The rapid development in lamps and auxiliary apparatus calls for a careful consideration of all devices on the market and last, but most important of all, is the consideration of local conditions.

In current consumption per candle power the arc lamp is more efficient than the incandescent, and the numerous improvements made in the mechanism and electrodes has brought the various types of arc lamps to a high degree of perfection. The luminous or magnetite arc and the flaming arc are perhaps the most used. The magnetite arc lamp, also called the luminous arc, gives a distribution and quality of light superior to the early types of arc lamps. The electrodes used in this lamp differ from those in other forms of arc lamps heretofore used. The upper electrode is of copper and the lower electrode is of magnetite, from which material the lamp derives its name. The life of the upper electrode is from 2000 to 8000 hours, and the lower, from 120 to 150 hours, depending upon the current adjustment. This lamp is made in various forms, each with different characteristics, such as current consumption, efficiency, light distribution and for either pendent suspension or mounting upon an ornamental post. The magnetite lamp is made for direct current series street lighting circuits, which requires special station apparatus.

Carbon arc lamps divide themselves into three classes, those that use solid carbons, cored carbons and flaming-arc carbons. The first two classes depend essentially, for their light producing, upon the continuous-spectrum radiation of highly heated carbon in the positive crater. The only purpose served by the cored carbons is the centralization of the arc. In the third class, however, the arc itself yields the principal share of emitted light. The most efficient lamp on the market today, in current consumption per candlepower, is the flame arc lamp. The characteristics of this lamp are high efficiency, the maximum light in the lower hemisphere, the color value of the light and the ability to change the color by impregnating the carbons with chemicals. These lamps are made for operation on both direct and alternating current and on series and multiple circuits. The principal objection to the flame arc lamp has been the delicate mechanism, the high cost of trimming and the depreciation in candlepower throughout the trim. These lamps are also made in various forms and for both pendent and post mounting. There are numerous makes of arc lamps on the market under different trade names, but the principle involved is more or less similar to the several types mentioned. There is quite a field for the different types of arc lamps, but it would be well to consider the various items of first cost, depreciation, current consumption, adaptability maintenance and reliability. It has not been considered good practice to make an installation of less than several hundred arc lamps, or to use arc lamps for the lighting of narrow streets where a low average intensity of light will be sufficient. The candlepower of

the various arc lamps depreciates more or less from one trimming and cleaning to another and it might be advisable when using certain types to clean between trims.

The luminescent lamp, of which the quartz-tube mercury vapor is perhaps the best known, has not made much progress in this country, but is used to a large extent in European countries. This lamp has the next highest efficiency of any artificial illuminant, the flaming arc being the highest. There have been some marked improvements in the quartz-tube lamp recently and it promises to be a strong competitor of both the arc and incandescent lamps.

From the first incandescent lamp, with a filament of carbon and a current consumption of four or five watts per mean horizontal candlepower, to the present type of gas-filled lamps with an efficiency of 0.6 watt per candlepower, there has been quite a few steps through a number of important stages in lamp development. The incandescent lamp has been popular for both interior and exterior lighting, due to its ability to operate successfully under different conditions, its reliability, low maintenance, high efficiency in the late types and to the fact that it is made in a variety of sizes for street lighting, from 60 to 1000 candlepower.

There has been many attempts to combine the desirable features of the incandescent lamp and the arc lamp in one lamp, but until recently little progress has been made. There is now, in the experimental stage, an arc lamp with tungsten electrodes, operating within a sealed bulb, and it promises to give excellent results. The electrodes are not consumed, as is the case with the present types of arc lamps, and the efficiency promises to be higher than even the best gas-filled incandescent lamps.

The light flux, radiating from any source, may not give just the result desired or a large percentage may be lost. Consequently it is necessary that some means should be employed to control the light rays and direct them to the plane to be illuminated. This is done in various ways. A lamp may give just the desired distribution, if the mounting height and spacing is just right. As this condition is usually impractical, it becomes necessary to redirect the light by the use of reflectors or refractors.

There are numerous types of reflectors on the market, and, as a rule, it is possible to select a form that will fill the requirements, although occasionally the engineer is compelled to design a reflector to meet his needs.

As a point midway between the lighting units has the lowest intensity of light, it is desirable to strengthen the light at that point by concentrating most of the light emitted by the lamp to an angle that will project the light to the distant point.

Whether reflectors should be used or not and selection of the proper type depends upon other conditions. When the lighting has a strictly utilitarian purpose, greater efficiency can be obtained by the proper use of reflectors. If ornamentation is desired, or building facades are to be lighted, as well as the street, then perhaps the bare lamp or lamps, equipped with some form of diffusing globe, will give satisfactory results.

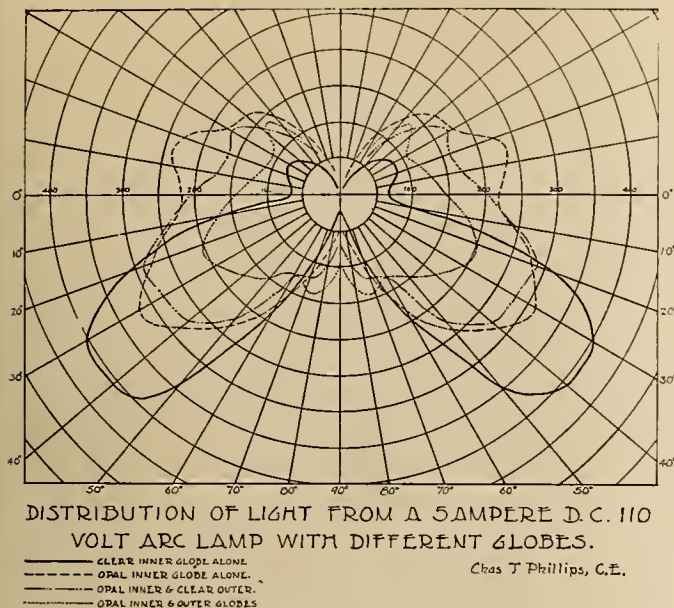


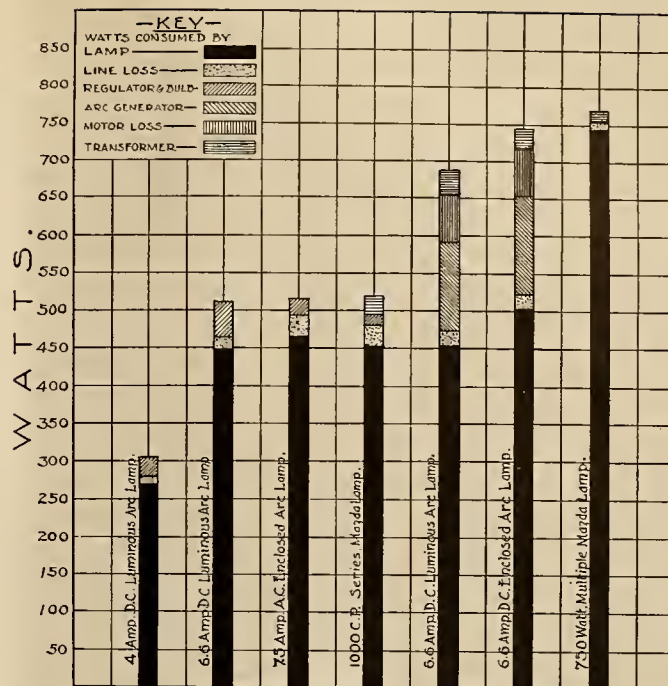
Fig. 1. Effect of Glassware in Light Distribution.

It is hard to realize the effect that different glassware, or combinations of glassware, will have on the light distribution curve. Fig. 1 shows the effect on the distribution curve of an arc lamp. In the selection of glassware, the absorption factor should be given careful study, as this will vary from 15 to 80 per cent. Where glassware has selective absorption, the type of lamp with which it will be used should be considered. There is diffusing glass which is free from selective absorption and there are other kinds which give selective absorption in the red and yellow, and others, in the blue. It can be easily seen that if a diffusing glass which gives selective absorption in red and yellow is used with a flaming arc lamp, the rays that are the most brilliant will be absorbed strongly, thus giving a reduced efficiency.

It should be remembered that an item of extreme importance in a system of street lighting are the globes, shades or reflectors, because through them the greatest loss of illumination occurs.

Operating cost consists of so many variable factors that it can only be considered for each individual case. If the lighting is on a moonlight, all-night or midnight schedule, the effect upon the majority of the items of maintenance will be different and consequently there is no rule that can be followed. All-night service should obtain the lowest rate for current, all-night, moonlight schedule should obtain the next and the current cost for midnight service should be the highest.

The cost of electric energy is an important factor in street lighting and this cost will vary in different locations. The power company or municipal plant furnishing current will have to base the charge upon the annual load factor of the street lighting system, upon the fixed charges and also upon such variable charges as may enter into the generation of current. The quantity of current required during the peak load will have to be considered. It has however been customary for power companies to strike an average scale of rates to cover their entire system, although in special cases, where load-factor or other conditions are unusual, special rates are made. Street lighting, in most cases,



COMPARISON OF ENERGY CONSUMPTION OF DIFFERENT SYSTEMS OF STREET LIGHTING.

CHAS. T. PHILLIPS, C.E.

Fig. 2. Comparison of Energy Consumption of Different Systems of Street Lighting.

is an all-night load, and it is considered desirable business by most power companies.

Comparisons of energy consumption for different systems of street lighting are shown by Fig 2. This is a general comparison and is not intended to show in detail, the actual losses in all installations, as line losses, transformer efficiency, etc., will vary in each instance. It is assumed that energy is taken from the bus bars at 2200 volts, single-phase, sixty cycle.

"America's Electrical Week" has been selected by the campaign executive committee of the Society for Electrical Development, Inc., as the official name for the great electrical celebration, December 2 to 9, 1916. A start has already been made on the nation-wide campaign, which from every indication will surpass even the wonderful results accomplished by the 1915 "Electrical Prosperity Week." The name "America's Electrical Week" was chosen this year because of its timeliness, the patriotic thought it conveys, the national aspect the name indicates, its euphony, and its appeal to every citizen. The date is practically the same as that of last year, which was generally conceded to be the best time of the year, as it began the Christmas drive for big business. An advisory committee met at the offices of the society, March 1st, to discuss and take action on preliminary plans for the big movement. It was decided to have an open poster competition for the best design for the week. America's most prominent artists will be invited to participate. Cash prizes will be awarded for the most appropriate design. The contest will soon be announced throughout the country. Many new sales and publicity features will be introduced in the plans for the 1916 electrical week. The electrical industry knows what can be done by a concerted drive for business, and other business interests and the public at large have learned of the tremendous possibilities for an annual electrical week. The pioneer work has been done; a greater public interest in electricity has been created; there is a greater commercial spirit in the industry itself and both the industry and the public are in a more receptive mood.

INCREASING LOAD FACTOR IN ORDER TO DECREASE DETERIORATION OF ELECTRIC APPARATUS.

BY F. G. BAUM.

(Proof of the truth in the apparent contradiction that constant use prolongs the life of electrical equipment is here given. Mr. Baum is a consulting engineer at San Francisco.—The Editor.)

The physical characteristics of the material used in electrical insulation are quite different from the metals and other materials with which they come in contact in electrical apparatus.

The specific heat, conductivity and temperature coefficient of expansion of insulating materials are quite different from copper, steel, air, oil, etc., with which they come in contact. Under temperature changes therefore there must necessarily be relative movement between the insulating material and the materials with which they come in contact. And since the insulating materials are all weak physically, they are more or less damaged by the relative motion occurring due to expansion and contraction as a result of temperature changes. The only way to avoid the damage to the insulation is to avoid the temperature changes in order to have no relative motion.

This means, of course, that all insulating materials should be maintained as nearly as possible at one operating condition. The way to do this most effectively is to keep, as nearly as possible, a constant output. This means that there is less deterioration in electrical apparatus if kept constantly in operation at one operating temperature than there will be if operated intermittently.

A generator that is operated very hot over the peak is damaged to a certain extent each time it is taken out of service and cools. If this is repeated each day the cumulated damage will, after a time, cause a break down. The same is true of nearly all electrical apparatus.

If a water pressure pipe line is emptied on a hot day more or less damage is done, and the action in a generator and other electrical apparatus is very much the same. We avoid temperature changes in pipe lines, and we should avoid them in electrical apparatus as far as possible. It is usually better to keep the temperature up than to have damage done by temperature changes.

That most of us have experienced less trouble as electric systems have increased their load factors is not then altogether due to improvement of apparatus, but largely to the fact that the apparatus deteriorates less when in continuous use than when used only a few hours a day. In this respect electrical apparatus differs from most other machinery and plant equipment. A more general recognition of this principle by electrical managers will make them more keen for business that keeps all apparatus at work as much as possible.

A generator of the enclosed, forced-ventilation type has less deterioration than the open type, partly because of better and more positive ventilation, but largely because of the more even temperature of the windings. Still better results will be obtained if we control the humidity of the air going to the generator.

The wonderful operating results of the oil type of transformer is due almost entirely to the fact that temperature changes are reduced resulting in less deterioration in coils and oil, and the oil lubricates the surfaces which rub in expansion and contraction. An oil type of transformer under one constant load and temperature should operate almost indefinitely with little deterioration. Cold oil will cause condensation and the absorbed water reduces the insulating value of the oil.

The same principle holds for motors, meters, underground and overhead cables, etc., and all insulated wires and material, and it is best to maintain the entire system under steady load and constant temperature as far as this can be done. This of course means that we should build up the load factor to decrease deterioration.

Even high tension transmission lines are maintained in better condition when continuously "hot" even when the line is not required to carry the load. Under the action of the electrical stress the porcelain insulators are maintained in better operating condition when normal voltage is maintained on the line than if the line is taken out of service daily. The practice of some companies in taking transmission lines out of daily service when not needed is therefore wrong.

The pin type of insulator is subject to less strain due to temperature changes than is the suspension type, as is shown in actual experience. This may be due to the better protection and less rapid temperature changes of the pin type. Perhaps the failure of suspension insulators would be materially reduced if constant potential were kept on the line.

In the operation of transmission lines for a large system I gave orders fourteen years ago to keep all lines in service except in case of trouble or when necessary to make repairs. Reliable data as to the causes of failures of suspension type insulators is needed.

It is fortunate for the electrical industry that the deterioration of insulating materials is less when the apparatus is kept at work than when idle, and hence there should be every attempt made to increase the load factor of the system.

And inasmuch as better load factors mean reduced capital cost and more revenue, in addition to less deterioration, it is important for the industry as a whole that this principle of constant use to reduce deterioration should be more generally appreciated. The wisdom of the policy of such men as Mr. Insull, who believe in one general electrical system for an entire district, will be appreciated more as the electric system becomes better known.

Electric cooking is to be taught in the domestic science department of the Oregon Normal School at Monmouth. The Oregon Power Company is furnishing the current.

Ultra-violet radiations from arc lamps and sunlight kills living cells by changing the protoplasm so that certain salts can combine with it to form an insoluble compound or coagulum.

REPORT ON COLUMBIA RIVER POWER PROJECT.

BY L. F. HARZA.

Appendix I—Estimate of Capital Cost and Annual Cost of Power.

(Concluded.)

Contingent margin. The total cost of each item as given in the estimates which follow all include a margin of 25 per cent to cover engineering, administration during construction, and contingencies in addition to the amounts obtained by applying the foregoing unit prices, except in the case of the generating machinery; in this case only 15 per cent was allowed, as these estimates are based upon the higher of two or more actual quotations in nearly all cases, and the manufacturer himself would furnish the engineering talent except for erection, which item has been included in the estimate.

ESTIMATE OF CAPITAL COST.

Dam for Closing Present Channel:

Scheme A (Fig. 31) + 25 per cent.....	\$3,325,000
Scheme B (Fig. 31) + 25 per cent.....	2,288,000
Scheme C (Fig. 31) + 25 per cent.....	3,344,000
Scheme D (Fig. 31) + 25 per cent.....	3,056,000
Scheme E (Fig. 32) + 25 per cent.....	3,485,000
Scheme F (Fig. 32) + 25 per cent.....	3,419,000

Use for estimate \$3,350,000

Controlling Dam:

Camere type of dam; approximate quantities as designed for 81 ft. controlled depth.	
25,000 tons structural steel.	
4,000 tons cast steel.	
230,000 cu. yds. of concrete.	
1 travelling gantry crane.	
Estimated cost, reduced 25 per cent, for 67 ft. controlled depth plus 25 per cent contingent fund	\$3,851,000

Tainter gate type of dam, approximate quantities as designed for 81 ft. controlled depth.	
41,600 tons structural steel.	
21,800 tons cast steel.	
480 tons steel cable.	
312,450 cu. yds. concrete.	
Estimated cost, reduced 25 per cent, for 67 ft. controlled depth plus 25 per cent contingent fund	8,837,000

Use for estimate of controlling dam... \$8,837,000

Flood Channel:

Approximate quantities:	
2,078,000 cu. yds. rock excavation, above elevation 84.0 (sill of flood gates) plus 25 per cent	\$2,078,000

Diversion Channel:

Approximate quantities:	
1,243,000 cu. yds. rock excavation for diversion channel below elevation 84.0.	
140,500 cu. yds. concrete.	
810,000 F.B.M. timber for cribs.	
8,000 cu. yds. rock fill in cribs.	
Estimated cost of diversion channel and closure of same plus 25 per cent.	2,872,000

Ice and Drift Sluice, Oregon Side:

Approximate quantities:	
252,000 cu. yds. rock excavation.	
28,300 cu. yds. concrete.	
320 tons structural steel rollers.	
Estimated cost plus 25 per cent.....	452,000

Wing Walls for Rock Fill Dam:

Approximate quantities:	
42,500 cu. yds. concrete plus 25 per cent	266,000

Main Floating Boom and Piers:

Approximate quantities:	
11,394,000 F.B.M. of timber.	
1,055 tons of rods and drift pins.	
3,000 cu. yds. concrete.	
46,000 cu. yds. rock fill in piers.	
Estimated cost plus 25 per cent.....	493,000

Power Canal:

Approximate quantities:	
4,229,000 cu. yds. rock excavation.	
136,000 cu. yds. rubble walls.	
17,960 cu. yds. concrete lining.	
1,000,000 cu. yds. sand excavation.	
Two floating booms.	
22,000 cu. yds. concrete.	
110 tons structural steel roller dams.	
Estimated cost plus 25 per cent.....	\$5,394,000

Jetty at Intake to Power Canal:

Approximate quantities:	
4,430,000 F.B.M. of timber.	
665,000 pounds rods and drift pins.	
2,470 cu. yds. reinforced concrete.	
164,000 cu. yds. rock fill.	
73,000 cu. yds. sand excavation.	
Estimated cost plus 25 per cent.....	285,000

Rebuilding Five Mile Lock:

Raising walls and gates and building draw span, plus 25 per cent.....	106,000
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Forebay and Power House Substructure:

(Location A, Fig. 7.)

Approximate quantities:

1,584,000 cu. yds. dry rock excavation.	
137,500 cu. yds. rock excavation for removal of coffer dam.	
429,250 cu. yds. concrete.	
5,000,000 pounds steel reinforcement.	
3,500,000 pounds structural steel for penstock gates.	
2,300,000 pounds cast steel for penstock gates.	
1,024,000 pounds steel trash racks.	
24 filler gates and drain gates.	
\$375,000 for cofferdamming and pumping.	
Estimated cost plus 25 per cent.....	\$5,852,000

Power House Superstructure:

76 ft. x 1670 ft. station building.	
Fishway.	
Tunnel through building for railroad.	
Steel bridges for spanning forebay and tailrace.	
Estimated cost plus 25 per cent.....	\$1,475,000

Power House Machinery:

23 vertical shaft, 35,000 kw. (50,000 k.v.a.). 25 cycle, 11,000 volt, 75 r.p.m. 3-phase generators, including stator and rotor, but not shaft or bearings.	
23 mechanically driven exciters, 500 kw. each; switchboard, low tension oil switches, bus bars, and all miscellaneous electrical equipment.	
23 50,000 h.p. vertical shaft, 75 r.p.m. turbine units including shaft and all bearings, governors and oil system.	
2 250-ton traveling cranes in power house and 2 50-ton traveling gantry cranes serving penstock gates; miscellaneous small equipment.	
Estimated cost plus 15 per cent.....	12,353,000

Reconstruction of Railroads:

Total estimated cost plus 25 per cent..	687,000
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Other Property Damage

.....	904,000
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Total physical cost \$45,404,000

Add for interest during one-half of five-year construction period at 4 per cent, equals 10 per cent..... 4,540,000

Total estimated capital cost \$49,944,000

Use for total capital cost \$50,000,000

Annual cost of generating primary power. The following items are independent of the interest rate on capital investment:

Depreciation—Reserve fund assumed to earn 2 per cent interest and sufficient to replace all depreciable parts every 15 years, and to refund the cost of all nearly permanent structures, rock excavation, concrete, etc., every 50 years (average value 3 per cent).....	\$1,500,000
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Maintenance and Repairs—For maintenance and repairs on the turbine units, in addition to depreciation fund, per annum	\$112,800
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Maintenance and repairs to generators and electrical equipment, 1½ per cent	74,000
Repairs to movable dam	50,000

Painting, average of one coat per annum, 43,700 tons of exposed steel (total in use) at \$1 per ton.....	43,700
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Operating suction dredge to prevent possible accumulation of sand bar at canal intake, 300 days, \$100 per day.	30,000
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Maintenance of building, replacing roof every 5 years, plus 50 per cent for other repairs	2,400
Contingent maintenance and repair expense	50,000

Total for maintenance and repairs..... \$362,900

Attendance and administration 100,000

Total annual expense exclusive of interest \$1,962,900

The rate of interest to be paid on the capital investment will depend largely upon the basis of financing. To show the relation of this to the annual cost

of power, interest rates of 3 and 4 per cent have been assumed as representing public development under different conditions. There has also been assumed a rate of 6 per cent on securities originally discounted 10 per cent, plus 1 per cent taxes, this basis being intended to represent approximately the cost under corporate financing. The results are as follows: No sinking fund has been provided as it is not properly chargeable to the cost of generation. The depreciation or amortization fund would provide for keeping the project permanently in first class operating condition. A water power property is of such unquestionably permanent value as to make it unnecessary to recover the principal in a short time as with many industrial enterprises which are subject at any time to the necessity of complete liquidation due to unforeseen competition. In the case of corporate finance, especially, a sinking fund might, however, assist in securing easier terms in marketing the securities but in any event is amply covered by the 25 per cent contingent fund. A 50 year sinking fund drawing 2 per cent interest would involve an annual expense of \$1.20 per continuous electrical horsepower.

Three per cent basis:

Depreciation, maintenance and repairs as above	\$1,962,900
3 per cent interest on \$50,000,000.....	1,500,000
Total annual charges	\$3,462,900
Annual cost per peak electrical horsepower year of base load (480,000 h.p.)	7.22
Add 25 per cent	1.80
Use	\$ 9.02

Four per cent basis:

Depreciation, maintenance and repairs as before	\$1,962,900
4 per cent interest on \$50,000,000.....	2,000,000
Total annual charges	\$3,962,900
Per peak horsepower year	8.27
Add 25 per cent	2.07
Use	\$10.34

Six per cent basis:

Depreciation, etc., as before	\$1,962,900
Add for 6 per cent on securities originally sold at 10 per cent discount, equivalent to 6.67 per cent.....	3,340,000
Add for taxes 1 per cent	500,000
Total annual charges	\$5,802,900
Cost of power on usual basis of private enterprise per peak horse power per year	12.10
Add 25 per cent	3.03
Use	\$15.13

Cost of generation contingent upon sale of surplus power. If the sale of the surplus power is to be assumed, then an additional item of depreciation should be added to provide for the possibility of severe runner erosion for the low head units when operating at heads above 80 ft. The value of one runner including freight and erection would be about \$27,000.

About seven low head units are required to operate at 80 ft. head to produce 800,000 h.p. with a decreasing number at the higher heads where the erosion would be most severe. If we assume to replace all seven runners every three years, the annual additional charge would be \$63,000, say \$75,000. This item is very small compared with the additional profit which the surplus power should bring.

It might be assumed roughly that 11 months' surplus power be worth 80 per cent of the value of continuous power, 10 months' power 60 per cent and 8 months' power 30 per cent.

If the various prices now be weighted according to

the amount available, and using the price of primary power as unity, there will result:

480,000 × 1.00 =	480,000
120,000 × .80 =	96,000
100,000 × .60 =	60,000
100,000 × .30 =	30,000
800,000 actual or 666,000 weighted power	

The quotient of these totals or 0.8333 now represents the average unit value of all power, as a proportion of the value of primary power, and 666,000 represents the equivalent primary power to produce the same income. If all power were to be sold at prices bearing the above ratio to each other, the actual costs of production of primary power would then be obtained by first adding \$75,000 to the annual charges and then dividing by 666,000.

Based upon 3 per cent interest:

Former annual charge	\$3,462,900
Add for runner depreciation	75,000
Total	\$3,537,900
Add 25 per cent	884,000
Use	\$4,421,900
Cost per peak primary horsepower	6.63
Cost per 11 mo. surplus h.p.....	5.30
Cost per 10 mo. surplus h.p.....	4.00
Cost per 8 mo. surplus h.p.....	2.00

Based upon 4 per cent interest:

Former annual charge	\$3,962,900
Add for runner depreciation	75,000
Total	\$4,037,900
Add 25 per cent	1,009,500
Use	\$5,047,400
Cost per primary horsepower	7.58
Cost per 11 mo. surplus h.p.....	6.06
Cost per 10 mo. surplus h.p.....	4.55
Cost per 8 mo. surplus h.p.....	2.27

Based upon 6 per cent interest—on securities sold at 90:

Former annual charge	\$5,802,900
Add for runner depreciation	75,000
Total	\$5,877,900
Add 25 per cent	1,469,500
Use	\$7,347,400
Cost per primary horsepower.....	\$11.02
Cost per 11 mo. surplus h.p.....	8.82
Cost per 10 mo. surplus h.p.....	6.62
Cost per 8 mo. surplus h.p.....	3.31

The computations for the capital cost and cost of power for the case in which a period of ten years was allowed for building up the load, were made by starting with the initial investment necessary to deliver one-tenth of the power, and then progressively adding for each year the deficit, or difference between interest on the previously accumulated investment, operating expenses, etc., and the earnings of the year in question, to the investment of the previous year. It was necessary to first assume a price of power and, after computing the transactions of the ten-year period, to then correct this assumption by a process of successive approximations until an assumption was made which provided the desired 25 per cent margin at the end of the ten-year period. The results of these computations were tabulated in an earlier part of this chapter.

Wireless telegraphy and telephony is considered in the annual report of the Postal Telegraph Cable Company as being of "incalculable value for the protection and direction of ships and for the changing conditions of the battlefield or other places where poles, wires or cables cannot well be erected or maintained, but nothing has caused your trustees to change or modify their opinion that, as commercial propositions, wireless telegraphy and wireless telephony are and will continue to be negligible."

ELECTRIC IRRIGATION PUMPING IN IDAHO.

BY W. T. WALLACE.

(After tracing the recent increase in irrigation pumping and detailing its advantages over gravity supply, the author cites the results of recent survey conducted by the power companies, wherein it was developed that plant efficiency rather than power rates was the most important factor in power costs. This paper was presented at the annual convention of the Idaho Society of Engineers, at Burley, Idaho, February 22, 1916.—The Editor.)

Past Progress.

Lifting irrigation water direct by means of current wheels has been practiced for many years in Idaho. The new era of electric pumping is no more than well started. The first installations, few in number and of small capacity, were first operated in the summer of 1908. Their success led to many installations the following year. Within the last five years the growth of this business has been rapid and most of the large projects have been installed within that period. Up to the season of 1915, within the territory now supplied by the Electric Investment Company, a total of 16,005 h.p. in motors had been installed for irrigation pumping to water a total of 100,141 acres. One hundred and fifty individual plants, rated at 798 h.p. total were in use, watering 5953 acres, the average capacity being 5.3 h.p. Among these are 131 plants ranging from $\frac{1}{2}$ to $7\frac{1}{2}$ h.p., inclusive, with a total rating of 478 h.p., and an average rating of 3.6 h.p., and 19 plants ranging from 10 to 35 h.p., with a total of 320 h.p. connected load, with an average rating of 16.8 h.p. This shows that by far the greater number of individual plants are of very small capacity.

There were 87 irrigation projects in operation in 1915, with a total of 15,207 connected h.p. for watering 94,188 acres. The average size of plant was 175 h.p., and the average acreage was 1803. The maximum lift was 200 ft., and the average lift was 94.7 ft.

Field for Pumping.

There is no sharp dividing line between the economical field for irrigating by gravity systems and by pumping plants. As a general rule, the gravity system is to be preferred where water can be supplied at a lower cost than by pumping. However, there have been numerous cases where long stretches of bad side hill construction through dangerous ground have been necessary for gravity systems, resulting in washouts, sinking ground, replacement of dirt sections by pipe lines or flumes, which in the end have made the cost of maintenance so excessive that a pumping plant would have been more economical, although the original estimates gave the advantage to the gravity system. The pumping plant has an important advantage in regard to insurance of service. A gravity system supplied by a single long canal is subject to many interruptions from treacherous side hill construction, cloudbursts and washouts caused by gophers, muskrats and crawfish, which are not experienced with large pumping systems having several canals of short length in comparatively flat ground.

There are large tracts of fertile land lying along the Snake River which can be watered under reasonable pumping lifts, but for which a gravity system is impracticable because of the extreme length of

canal necessary, due to the flat grade of the river. The water supply for such lands is still abundant, and there should be no restriction as to installation of additional pumping systems for this reason for many years, particularly along that part of the Snake River west of Hagerman. There are several thousand second feet flowing into the Snake River from many large springs above this district, such as the Thousand Springs, Box Canyon, Clear Lake and the Malad River, which will insure an ample water supply although the river above may be absolutely dry.

There is a large field for small individual pumping plants watering lands lying above the present gravity ditches. Such plants cannot be of high lift, as lands so watered must bear their share of the first cost and the maintenance charges of the gravity system, in addition to their pumping installations and power charges. A great many small installations of this type are proving profitable to their owners, and doubtless many more will be installed. It is often possible to water considerable tracts of land above such ditches with a total lift not exceeding 10 ft., in which case the additional power charge per acre is not an excessive burden to add to the regular canal charges. In some cases the water for such lands is supplied at a less charge for the canal rights than paid by the lands beneath the ditch, which encourages the watering of the higher lands.

In many of the western states water from wells is one of the chief supplies for irrigation pumping. This field has been but slightly developed in Idaho, but will doubtless grow in importance as other supplies are exhausted and as the level of the ground water under large tracts is raised by other irrigation systems. The pumping of irrigation water from wells has peculiar advantages to the irrigator, because of the fact that such water does not carry and spread upon the land the seeds or means of propagation of weeds and other rank growths as does the water supplied from long, open ditches. This same advantage exists, to at least some extent, in favor of all pumping plants because of the shortened length of canals.

Irrigation Pumping Investigations.

At the time of these original installations high efficiency stock centrifugal pumps were not on the market, and the importance of selecting efficient machinery, suited to the characteristics of the special case, as well as the necessity for proper installation, were not fully appreciated. Furthermore, proper advice was not always readily obtainable, and the dealer who offered the cheapest equipment and who represented that it would deliver the required water, often secured the order, regardless of efficiency, durability or economy. A better understanding of the necessities of the irrigator, but particularly the manufacture of small stock pumps having greatly increased efficiencies, have tended during the past two years to smooth out some of these early difficulties, but there is still a great deal to accomplish in this direction.

In the summer of 1913 the Bureau of Irrigation Investigations of the Department of Agriculture secured records of a number of pumping installations in the Payette district, from which the plant efficiency, power consumption, duty of water, etc., were learned.

In the spring of 1915 the various power companies operating in the southern part of Idaho decided to make a thorough investigation of the pumping situation. All possible data were secured that would throw light on every side of the question. Complete records for 1914 were collected so far as they were available. In many cases it was impossible to secure the necessary information, as no records had been kept by the owners. Accurate tests of the efficiency of more than eighty plants were made during the season of 1915. These investigations were pushed during the summer and the tabulation of all returns was completed during October.

A surprising variation in results was disclosed. Among the private pumping plants ranging from 1 to 35 h.p., the cost of power in dollars per acre varied from \$1.25 for an eighty-acre tract supplied by a 4 in. pump under a 21 ft. head, to \$60 for a one-acre orchard supplied by a 3 in. pump under a 30 ft. head; the season load factor was from 7/10 of 1 per cent to 66.9 per cent, and the price paid per kilowatt hour under these conditions ranged from 9/10c to 48.2c at the same power rate. The combined efficiency of motor and pump varied from 5 per cent in the case of a 1½ in. pump and 8 per cent for a 2 in. pump to 46 per cent for a 2 in. and 63 per cent for a 10 in. pump. The cost of power for lifting an acre foot of water one foot was from 3c to 68c among the plants for which this calculation was made, which did not include all those tested.

Among the irrigation projects, including all the large installations in the state, the variation in cost per kilowatt hour was from 72/100c to 1.56c; the load factor for the season was from 34 per cent to 67 per cent; and the cost of power per acre foot per foot lift was from 1.6c to 4.2c. It should be stated, however, that in many cases information was incomplete, both for individual installations and irrigation projects. Doubtless complete data would have shown wider variations than those mentioned.

As a rule, the owners of irrigation plants were entirely in the dark as to suitability of their equipment or as to the efficiency at which they were operating. Water which had been pumped at large cost was often badly used and needlessly wasted. Motors were being operated at from 49 per cent to 124 per cent of rated capacity, while the power was supplied on a flat rate based on the manufacturer's rating of the motor. Many suction and discharge lines were found to be undersize for the best economy and obstructed by needless short radius 90 deg. bends, valves, and miscellaneous pipe fittings, which greatly increased the effective head.

Many users of power for irrigation purposes had complained regarding the power rates, and the Utilities Commission had taken the whole matter up for investigation, and it was by reason of these facts that the power companies undertook as elaborate and careful an investigation as time permitted, and as many tests as possible were conducted to determine the efficiency of existing plants, all to the end that as much light as possible might be thrown on the problem of arriving at equitable rates for this service.

In the vast majority of cases all consumers of power for irrigation purposes had been using such power on one form or another of flat charge, based almost entirely on the manufacturer's rating of the motor, and the above investigations and tests disclosed the fact that many users of power under these rates were in the habit of starting up their pumping plants at the beginning of the irrigation season and letting them run continuously throughout the season, in many cases making no use of the water so pumped except to let it run down the hill again into the canal or river from which it may have been taken.

On the other hand, many users of power were making as economical a use of the service as was possible for them to do, all things considered.

The tests early developed the fact that in many cases the problem was not so much a question of power rates as it was a question of plant efficiency, and this is a matter which it is not always easy to get the irrigator to understand. If one of these irrigators had an efficient plant installed, and was operating the same, and then had deliberately permitted from fifty to seventy-five per cent of the water pumped to run back into the waste ditch, and had undertaken to irrigate his land with the remainder of the water not so wasted, he perhaps, would have hesitated some before severely criticizing the power rate, but as a matter of fact, many irrigators were, in effect, doing this same thing, except that the cause was, perhaps, hidden under poor plant efficiency.

A thorough consideration of all the various angles of this matter which were brought out by this investigation, and by the tests made, early forced the conclusion that an equitable rate for this service must be measured service and not a flat rate, because it is under a measured service only that the careless user of the service can be required to suffer from his own negligence and waste, and it is only under a measured service that the economical user of it is rewarded for his economy.

Irrigation Power Rates.

The growth of the irrigation pumping load has been such during the past four or five years as to cause the maximum load on the generating stations of the power company to occur during the summer months, when the irrigation load is being carried. This fact, when regarded from the standpoint of the power company, means, therefore, that the size of its installations at its generating plants and at its various distributing substations, is determined by the irrigation load, and as the use of power for this purpose is a seasonal use, and is not continuous throughout the year, and as the generating station capacity and substation capacity so used during the summer months, is, to a large extent, idle throughout the balance of the year, it becomes apparent that any equitable irrigation rate must have incorporated in it that element of charge which is, in our business, designated as a demand charge, or in other words, a charge designed primarily to compensate, in a measure at least, for the accruing interest charges on the investment of the power company in generating stations, transmission lines and substations.

The rates which are hereinafter set out will show that the demand charge is placed at \$12.00 per h.p. per annum, which, when compared with similar charges made and enforced by power companies generally throughout the country, is found to be a more than usually low charge.

After extended hearings before the Idaho Public Utilities Commission, during which all sides of the pumping situation were thoroughly considered and at which all parties interested, including representatives of important pumping projects, water users' associations, etc., were present and took active part, a new schedule of irrigation pumping rates was agreed upon and authorized by the Utilities Commission under which all power is to be supplied on a meter basis at a considerable saving to the average consumer. Although the new rates were not issued until December 14, 1915, all power supplied during the season of 1915 was billed according to them. These rates apply to all irrigation customers from Pocatello to Huntington, but many plants are operating under old power contracts which have some years yet to run and under which they can continue should the owners so elect.

Equitable power rates must be based on many considerations. They should be such as to encourage the economical use of power. This result cannot be secured under either a flat rate or a straight meter rate. The former tends toward wasteful use of kilowatt hours but keeps the size of motors down to the necessary requirements. The latter insures a fairly economical use of kilowatt hours but places no limit on the size of the installation. A customer will install a motor far in excess of his requirements in order to get the pumping done quickly, avoid caring for the water nights and Sundays, etc., which requires that an unnecessarily large portion of the generating equipment of the power company be reserved for his requirements. Consequently true economy for both the consumer and the power company can be insured only by a form of rate that will prevent waste of kilowatt hours and insure the minimum demand and maximum load factor for each plant. The irrigation rates authorized by the Utilities Commission provide for a moderate flat charge based on the maximum demand for the season and in addition, a kilowatt hour charge, the two resulting in very reasonable rates for either high or low load factors but encouraging the former. These rates are as follows:

RATE NO. 1.

For Installations of Less Than 14 Horsepower.

Demand Charge:
\$12.00 per year per horsepower of maximum demand, plus an
Energy Charge
As follows:
5 cents per kw.-hr. for first 45 kw.-hr per horsepower of maximum demand per month.
½ cent per kw.-hr. for all current consumed over 45 kw.-hr. per horsepower of maximum demand per month.
Discount of 5 per cent on monthly bill if paid within 10 days from date of bill.

Maximum Bill:

The company, under this rate, will not bill the consumer for irrigation pumping service more than \$28 net per horsepower of maximum demand for five months' service, nor more than \$33.60 net per horsepower of maximum demand for six months' service.

RATE NO. 2.

For Installations of 10 Horsepower to Less Than 25 Horsepower.

Demand Charge:
\$12.00 per year per horsepower of maximum demand, plus an
Energy Charge
As follows:
5 cents per kw.-hr for first 30 kw.-hr. per horsepower of maximum demand per month.
½ cent per kw.-hr. for all current consumed over 30 kw.-hr. per horsepower of maximum demand per month.

Discount of 5 per cent on monthly bill if paid within 10 days from date of bill.

Maximum Bill:

The company, under this rate, will not bill the consumer for irrigation pumping service more than \$28 net per horsepower of maximum demand for five months' service, nor more than \$33.60 net per horsepower of maximum demand for six months' service.

RATE NO. 3.

For Installations of 25 Horsepower to Less Than 100 Horsepower.

Demand Charge
\$12.00 per year per horsepower of maximum demand, plus an
Energy Charge
As follows:
½ cent per kw.-hr. for all current consumed.

Discount:

Consumers using service under this rate will be entitled to a quantity discount on their monthly bills as follows:

First \$100.00 of monthly bill. No discount.
Next \$100.00 of monthly bill 5% discount.
Next \$100.00 of monthly bill 10% discount.
Next \$100.00 of monthly bill 15% discount.
All over \$400.00 of monthly bill 20% discount.

Guarantee:

The consumer, under this rate, guarantees to pay the company for irrigation pumping service, a net minimum bill of \$15 per horsepower of maximum demand for five months' service, or \$18 per horsepower of maximum demand for six months' service.

RATE NO. 4.

For Installation of 100 Horsepower and Over.

Demand Charge:
\$12.00 per year per horsepower of maximum demand, plus an
Energy Charge
As follows:
½ cent per kw.-hr. for all current consumed.

Discount:

Consumers using service under this rate will be entitled to a quantity discount on their monthly bills as follows:

First \$1,000.00 of monthly bill 10% discount.
Next \$1,000.00 of monthly bill 20% discount.
All over \$2,000.00 of monthly bill 40% discount.

Guarantee:

The consumer, under this rate guarantees to pay the company, for irrigation pumping service, a net minimum bill of \$15.00 per horsepower of maximum demand for five months' service, or \$18.00 per horsepower of maximum demand for six months' service.

These rates cover irrigation pumping for a season of five or six months from April to September, inclusive. The maximum demand for Rates 1 and 2 is the horsepower rating of all motors supplied with service at any one time and for Rates 3 and 4 is the average of the four highest fifteen minute peaks in horsepower occurring at any time during the season, not more than one peak being counted in any one hour, and peaks being determined by curve drawing wattmeters.

The following table shows the low power rate which may be secured for various sizes of motors:

Cost of Power for Irrigation Pumping for Season of 180 Days.

Motor h.p.	Motor Efficiency.	Kilowatt Hour Load Factor.		Brake Horsepower Hour.	
		75%	100%	75%	100%
5	82%	1.14c	.855c	1.04c	.778c
15	84%	1.14c	.876c	1.01c	.778c
75	87%	.934c	.806c	.801c	.691c
100	89%	.896c	.786c	.751c	.658c
500	91%	.824c	.693c	.675c	.568c
5000	95%	.745c	.558c	.585c	.438c

At the close of the irrigation season the consumer may use current, not exceeding the pumping demand, for general power purposes at any point upon his premises, providing that the point of delivery by the power company is not changed. As the demand charge per year is the same whether this additional power is used or not, the service for the remaining six months is secured at the meter rate alone, resulting in a greatly reduced cost per kilowatt hour. The owners of individual pumping plants will find many uses for their motors for general purposes about the farm for which the cost of power under the low winter rate will be hardly a consideration.

The following table shows the cost of pumping an acre foot a foot high with motors operating at full

load and at 75 per cent and 100 per cent load factor for a season of six months.

The pump efficiencies assumed are for average lifts and may be secured with stock pumps up to and including the 75 h.p. set. Larger units should have pumps of special design.

Size.	Motor. Efficiency.	Pump Efficiency.	Combined Motor and Pump Efficiency.	Cost per Foot Acre Foot	
				75% L. F.	100% L. F.
5	82%	56%	46%	2.54c	1.90c
15	84%	63%	53%	2.20c	1.69c
75	87%	76%	66%	1.45c	1.25c
500	91%	79%	72%	1.17c	.99c
5000	95%	82%	78%	.98c	.73c

All of the above are single units with the exception of the 5000 horsepower installation which represents three or four units driven by synchronous motors.

Common Troubles of Pumping Systems.

Some of our large pumping projects have been created through the efforts of promoters who were ignorant or illy advised as to the fundamental requirements for success. Unreasonable pumping lifts were undertaken, and the cost of construction and maintenance was underestimated, the duty of water taken too low and no allowance made for seepage losses, which, with inflated land values, made it seem to the uninformed investor that the project had merit. Such projects are condemned at the beginning by their characteristics. In some cases it will, no doubt, be possible to reorganize and eliminate some of the higher lifts and wipe out a large part of the original investment, resulting in a modified project for which there is a probability of success. Some projects which might have been successful later have been installed 5 to 10 years ahead of their time. There is little hope for their immediate success, considering the price of equally good lands under gravity systems where the initial maintenance cost is moderate.

In order to make the illegitimate scheme as inviting as possible the cost of all equipment is skimped, cheap plants are installed, inadequate canal systems built, necessitating rebuilding and enlarging within a few years. If a project is legitimate in its fundamental characteristics, it may be given a severe handicap by such ill-advised reduction of first cost. The saving in power bills and general maintenance in a few years would wipe out the extra cost of a thoroughly efficient and substantial plant. For example, one of the important smaller irrigation districts was operating with equipment which gave it an overall efficiency of 52 per cent. This figure was so startling and the power charges had become so high that it was decided to rebuild the plant, which was done, the new equipment giving an overall efficiency of about 76 per cent, which will make a saving of approximately 32 per cent in the total power charge.

(To be continued.)

THE GREAT WESTERN ELECTRO-CHEMICAL COMPANY.

BY J. W. BECKMAN.

A transcontinental railroad without any feeders is as badly off as a power company with excess power, and no way by means of which it can stimulate the demand for it, and the development of same. Fully alive to this situation, the management of The Great Western Power Company started a research department, in

charge of an electrochemist. This department's office was to study conditions, especially in reference to the electrochemical and electrometallurgical lines, in the section of California that is served by this power company.

Through such studies and investigations it was assumed that a foundation might be laid for developments of industries, of a character as mentioned above. After extensive investigations, it was conclusively shown that the conditions were such that various electrochemical industries could be operated successfully on the Pacific Coast. The one which at this juncture seemed more promising than any other, was the manufacture of caustic soda and bleaching powder, also known as chloride of lime, together with other chlorine products.

A company was organized in January of this year, under the laws of California, with the name of the Great Western Electro-Chemical Company, with a capital of \$2,500,000. Eastern, as well as Western capital is represented in the organization. Messrs. Mortimer and Herbert Fleishhacker, bankers of San Francisco, represent the Western capital, while the Eastern capital is represented by Messrs. Franklin Remington, president of The Foundation Company of New York; and John F. Bush, now vice-president and general manager of the new company, but only until recently, for many years connected in executive position with one of the largest electrochemical companies in the East.

The company has a very broad charter, and anticipates entering the electrochemical and electrometallurgical field extensively on the Pacific Coast. Products which will be manufactured here by this new enterprise are such as cyanide, aluminum, various ferro alloys, such as ferrosilicon, ferrochrome, and others, calcium carbide, nitrogen fertilizers, zinc and potassium chlorate.

The first installation is now being erected at Pittsburg, California. A most favorable site has been purchased, comprising some 40 acres, facing on the San Joaquin River. Service from both the Southern Pacific, as well as the Santa Fe, is obtained at the site, as well as water transportation on the river. Power is furnished by The Great Western Power Company, one of the largest power producers on the Coast, at very favorable rates.

The plant now under construction will turn out caustic soda, extensively used by soap manufacturers and oil refineries, and bleaching powder, used as a disinfectant and bleaching agent—it covers 15 acres of ground, and will cost \$600,000. No explosives of any kind will be manufactured. This plant is the first of its kind west of Detroit, and the only one on this continent on tidewater.

The directors of the new organization are: Mortimer Fleishhacker, president, San Francisco; John F. Bush, vice-president and general manager, San Francisco; Arthur Lilienthal, secretary, San Francisco; Franklin Remington, New York City; Herbert Fleishhacker, San Francisco; Lem W. Bowen, Detroit, Michigan; J. W. Beckman, San Francisco; Sigmund Stearns, San Francisco; Louis Bloch, San Francisco.

LETTERS TO THE EDITOR.

Increasing the Range of the Electric Range.

Sir:—I have read with much interest your editorial in the issue of February 26th of the Journal of Electricity, Power and Gas, and am quite sure that you have touched upon one of the most important phases in connection with the work of developing the electric range business.

As a member of the Electric Range Committee appointed by the National Electric Light Association to bring in a report on this matter at the convention to be held in Chicago next May, I have had occasion to make a thorough investigation regarding the merchandising problems peculiar to the business, and in answer to my inquiries I have found that one of the principal difficulties in selling electric ranges is a general lack of knowledge on the subject of cooking by electricity.

It appears that a very small percentage of the consumers of any electric company seem to know that general cooking can be done by means of electricity, and those consumers who know anything about it as a rule have a very vague idea of the subject.

The public needs to be informed at the present time not so much regarding the advantages of one particular manufacturer's range over another as on the broad question of electric cooking, and after a consumer of a central station is informed he needs to be frequently reminded regarding the many advantages accruing from the use of the electric range for cooking purposes.

Concerted and co-operative educational edvertising by the manufacturers of electric ranges is what is needed at the present time, and if this work is done thoroughly by the manufacturers, the central stations will gladly contribute their share and utilize the pages of local newspapers in helping to spread the story regarding the usefulness of the electric range, and the advantages of electric cooking.

S. M. KENNEDY,

General Agent, Southern California Edison Co.

Sir:—We greatly appreciate the editorial which appeared in your magazine of February 26th on the electric range advertising situation. We will certainly follow this matter with the range manufacturers who are doing business in our territory.

Very truly yours,

C. R. PUTNAM,

Sales Manager Utah Power & Light Co.

Sir:—In line with your editorial suggestion of February 26th, I am writing various range manufacturers and also the Society for Electrical Development with the idea of interesting them in some form of general advertising to supplement our local activities relative to the sale of electric ranges on the Pacific Coast.

I must take exception to your statement, however, that the best prospects for electric ranges are in non-gas competitive territories, inasmuch as we have been just as successful in selling ranges to gas users as we have to other classes of customers.

It is our impression that a national campaign of advertising through popular magazines similar to that

which the Hotpoint company is planning to undertake will be very effective and of much assistance to the central stations and others selling electric ranges.

Yours very truly,

E. A. WILCOX,

Heating Expert Great Western Power Co.
Los Angeles, Cal.

Sir:—I have read your editorial in the Journal of Electricity, Power and Gas suggesting a co-operative local advertising campaign and I agree with you that in this case local advertising will bring much better results than national advertising, although I believe there are a great many eminent advertising men who take the opposite view that the greatest results are obtained from national advertising.

It certainly will give me great pleasure to write to the various district managers of the manufacturers of electric ranges, suggesting that advertising of their product could be most effectively done in small country weeklies and farm papers, at least for this particular section of the country.

Yours very truly,

G. B. McLEAN,

Sales Manager, Pacific Light & Power Corporation.

Sir: Referring to the editorial in the Journal of the 26th ultimo, on the subject of electric ranges, I have to advise that I fully agree with you that it is necessary for the manufacturers to go into the advertising very extensively, so as to create a general demand among housewives for the electric range, particularly in non-gas territory. We are giving this matter attention as far as our company is concerned, and are endeavoring in every possible way to impress upon the different manufacturers the absolute necessity of their doing their share in this work. I think I am safe in saying that on the whole the manufacturers are showing their willingness to do their share, although at the present time they are somewhat handicapped on account of the patent situation. As this seems to be fairly well cleared up now, I think we can look for greater activity in the advertising line in the very near future.

Yours very truly,

S. V. WALTON,

Manager Commercial Department,
Pacific Gas & Electric Company.

An electric copper smelter was recently installed at St. Johns, N. F., and at the initial test it is reported the plant worked admirably and a high grade of copper was produced, the "run" being made on material from Little Bay copper mines. The capacity of the plant exceeded the expectations of the expert here, who claims it will smelt about 1000 pounds of ore per hour. Operations on a commercial basis will be conducted by the Hydro Electric Smelting Company, Ltd., the capital of which is local. This company owns Little Bay mines, where it is claimed an abundance of ore exists on the surface, having been left by a company operating there several years ago, when a fall in the price of copper did not warrant a continuance of operations.

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Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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The increasing cost of supplies is now a serious problem in every branch of the electrical industry.

Increase in Supply Costs

This, coupled with the difficulty in obtaining delivery, is creating a condition where the buyer seeks the seller. Even many large companies have been caught unprepared in this emergency, as the rise in price had not been sufficiently foreseen.

Fundamentally, the increased cost of copper has been responsible for this condition, as copper is an important constituent in most electrical equipment. Statistics show that the United States is consuming copper at the record rate of two billion pounds per annum, which is ten million pounds a month short of the American smelting capacity. That most of this is being used for local industrial purposes is shown by the fact that copper and brass exports are less than before the war.

On the Pacific Coast, it is practically impossible to buy copper in less than hundred pound lots for earlier than July delivery—and this at prices close to thirty cents. Notwithstanding this high price, the demand continues to increase. Furthermore, it is the opinion of John D. Ryan, president of the Anaconda Copper Company, that "consumption will at least maintain its present level and that peace in Europe will bring an enormous demand to replace depleted stocks."

Other raw materials used in electrical work, such as steel and rubber, are likewise at high price levels, and as a consequence the prices of finished products are advancing rapidly, or, as is the equivalent, discounts are being reduced.

In a number of cases it is impossible for Western plants to get delivery at any price. Manufacturers are indifferent as to whether they make deliveries. Even after an order is placed the customer has frequently been notified that stock has been so depleted during the interval between the time that a quotation was made and the time that the order was placed that it could not be filled.

The greatest sufferers have been electrical contractors who have bid on construction work without figuring the possible change in prices during the interval that elapses between the time that an estimate is made and a contract awarded. In order to prevent future trouble on this account it is suggested that a clause be inserted in all bids, providing proportionate prices dependent upon changes in the cost of materials. Bids have been too low in the past, and are now certainly too low in proportion to cost. It is surely opportune for electrical contractors to have an understanding now on this matter and to set safe standards for future work.

With the ultimate return of normal conditions those firms who have done their best to serve their customers even in small matters will be the most likely to retain future custom. For, even, in business, gratitude is much more than "a lively appreciation of favors yet to come." The present condition is unequalled in the experience of most men now in busi-

ness, but they well may profit from the experience of others in that it is only true service that maintains and retains trade.

After four weeks' debate the Shields navigable stream water power bill has passed the Senate by a vote of forty-six to twenty-two and now goes to the House. That this notable result has been attained, notwithstanding the distractions incident to war and preparedness, should be a matter of congratulation to every one interested in the development of our latent water powers, which, like a sleeping giant, need but be put to work to create new wealth and support new peoples on lands now disused. This is the most notable Congressional recognition of Western needs to date.

The Shields bill, as it passed the Senate, is a splendid, practical measure. It will permit of the harnessing of water power in many parts of the country. Nor is this all. While Congress is not likely at the present session to make any great appropriations for the improvement of rivers and harbors, the great hydroelectric developments made possible by the enactment of this measure will make many rivers navigable far into the interior by private capital instead of by public taxation.

Briefly stated, the bill gives authority to the Secretary of War to approve a fifty year permit for the construction, maintenance and operation of dams and accessory works for the development of water power if, in his judgment, navigation will be benefitted, public purposes best served and conservation of water resources promoted. It provides that navigation facilities shall at least be equal to those existing prior to the new construction, that reasonable charges for the privilege and reasonable costs of federal investigation shall be paid and that a reasonable rental be paid for public lands occupied, the "reasonableness" to be determined by the Secretary of War, who is also to formulate all regulatory measures.

It is believed that this bill fully protects the public interest and yet provides sufficient incentive to justify the power developer in soliciting private funds. If passed by the House this bill should usher in an era of low head power developments exceeding in capacity the high head plants which have already made the West pre-eminent electrically. The power thus released for human utilization will make possible many irrigation and reclamation projects as well as materialize plans for electrochemical and electrometallurgical industries. Its probable enactment will mark an epoch in this electrical age.

With the Shields bill yet to pass the House and the Meyers' modification of the Ferris bill yet to pass the Senate, only half the action necessary to provide needed relief has been taken. Vigorous agitation against both these measures is being conducted by Gifford Pinchot and his followers, who seem to look upon these measures as a means of rescuing themselves from political obscurity. It is a fact greatly to be regretted that matters so vital to the economic progress of the West are at the mercy of politicians, who apparently value their own preferment above the common welfare.

One of the problems which perplex public utility operators is that of obtaining and retaining competent help. Wages constitute the largest single item in the cost of operating utilities and too frequently represent the least efficient return. The problem naturally divides itself into two heads—selection and retention.

Efficient methods in the selection of workers is an important factor in the subsequent efficiency of the worker. Proper system in the hiring of men will often obviate the necessity of firing them frequently. The experience of big companies has shown that a central employment bureau is preferable to individual action by the several foremen in direct charge of work.

Just as the centralized purchase of material by a purchasing agent is now standard practice, so should scientific selection of labor by a competent employment bureau supersede the present hap-hazard method, or rather lack of method, found in many establishments. It not only provides employes better fitted to the duties they are to perform, but also relieves executives of a task to which they may not be specifically fitted and saves their time.

Aside from the advantage of fitting men to their jobs and jobs to their men, such a plan promotes the esprit de corps of an organization. It knits them together more compactly, gives them the same ideals and enthuses them with the same spirit. In the public utility business, especially, it is desirable to have all employes in thorough sympathy with the public service company and its work. The influence of radical socialists is not always for the best, either among other employes or upon the public served. Each company has a small army of employes who can do much to make or mar favorable public attitude toward the company.

Furthermore a labor bureau eliminates favoritism and patronage in the selection of workers. A man is hired, not because he is a relative, a fellow countryman, or a member of the same society, but solely because he complies with the specifications required for a job and will provide an adequate return upon the investment involved in hiring him.

There are men, and more particularly women, who because of their intuitive power of character analysis, their painstaking attention to such detail as the keeping of records and their broad sympathy, make ideal recruiting officers. Their function is to recommend suitable help, to supervise transfer of misfits and to look after welfare work.

Due consideration of the welfare of workers is an aid to their efficiency of performance and to their retention. As the investment in each employe of a public service corporation is close to three thousand dollars it is evident that the retention of a good man is equally as important as his proper selection. Retention is easier when the relationship between employer and employed is close and sympathetic, as it is thus possible to have a mutual understanding and preserve the mutual interests. This can be accomplished by safety, athletic, debating, social and musical clubs, establishing play grounds and parks, all of which might well come under the supervision of the employment bureau.

Need for Employment Departments

PERSONALS

F. J. Quinn of the Manhattan Electric Supply Company is at Portland.

S. B. Gregory, Pacific Coast manager of the Arrow Electric Company, is in Portland.

Ira J. Wolfe of the Pittsburg Specialties Company, at San Francisco, is leaving for a trip into the San Joaquin Valley.

E. N. Fobes of the Fobes Supply Company of Seattle returned to the North after spending a week at San Francisco.

Paul Lebenbaum, electrical engineer with the Southern Pacific Company at Portland, was in San Francisco this week.

Gus Flannigan of the Electrical Engineering and Supply Company at Stockton, Cal., was a recent business visitor at San Francisco.

M. A. Bryte, Western representative of the French Battery and Carbon Company, has recently returned to San Francisco from an Eastern trip.

A. S. Kalenborn, electrical engineer with the San Joaquin Light and Power Corporation, has returned to Fresno after a brief visit to San Francisco.

A. A. Brown, assistant sales manager of the Westinghouse Electric and Manufacturing Company of New York, is a recent arrival at San Francisco.

E. G. Gauntlet, of the Safety Insulated Wire and Cable Company, who has been confined to his home owing to an operation, is now on his feet again.

Geo. E. Scarfe has resigned as superintendent of the Nevada district of the Pacific Gas & Electric Company, after sixteen years' service, being succeeded by **John Werry**.

L. M. Edwards has been made foreman of the Pacific Gas and Electric Company's de Sabla plant, following the transfer of **J. R. Carl** to the company's San Jose district.

L. F. Leury, formerly assistant to **Guy C. Bailey**, chief electrical and mechanical engineer at the Exposition, is now on the engineering force of **C. C. Moore & Co.**, engineers, of San Francisco.

James H. Gilhuly of the Western Conduit Company has returned to San Francisco from Los Angeles, reporting that the new conduit ordinance has made business prosperous for all conduit companies.

H. G. Aylsworth, of the Aylsworth Agencies Company at San Francisco, is going East the latter part of this month to look the situation over and visit the various factories represented by his firm.

C. G. A. Baker, vice-president and treasurer of Baker-Joslyn Company, is on a trip in the Northern territory. After spending several days at the Seattle branch of the company, he will return to San Francisco about the 21st inst.

F. A. Wood, of the Gamewell Fire Alarm System, is now at Los Angeles. This firm recently completed a contract for public fire alarm system for Corning, as well as one for Phoenix, Arizona, and Carson City, Hollister and Gilroy.

Paul M. Lincoln, engineer of the Westinghouse Electric and Manufacturing Company of East Pittsburg, Pa., and past president of the American Institute of Electrical Engineers, is expected to arrive at San Francisco in the near future.

W. T. Goddard, chief engineer of the Locke Insulator Manufacturing Company of Victor, N. Y., has been making an exhaustive study of the new conditions of the high tension transmission lines on the Coast, planning for a new type of insulator. He was a visitor at their Western representatives, Pierson-Roeding Company, of San Francisco, last week, and is now in California.

GREAT WESTERN POWER CABLE LAYING.

The laying of the shore end of the new San Francisco Bay cable of the Great Western Power Company was made the occasion of a pleasant party on the morning of March 14th, when the officials of the company and a number of invited guests inspected the new method devised by General Superintendent **E. W. Beardsley**. In less than an hour's time the cable was successfully laid from Yerba Buena Island to join a piece laid from the Key Route mole. Following is the list of those invited:

Alberger, W. R., vice-president and general manager San Francisco-Oakland Terminal Railways.
Babcock, A. H., electrical engineer Southern Pacific Co.
Beardsley, E. W., general superintendent Great Western Power Company.
Bell, J. P., Pacific Coast manager, Standard Underground Cable Company.
Brierly, F. A., The Pacific Telephone & Telegraph Company.
Bivens, T. E., United Railroads of San Francisco.
Briggs, W. W., general agent Great Western Power Company.
Bibbins, T. E., local manager General Electric Company.
Britton, J. A., vice-president and general manager Pacific Gas & Electric Company.
Brown, H. F., Metal Weld Company, San Francisco.
Burkett, C. W., chief engineer The Pacific Telephone & Telegraph Company.
Crawford, T. O., engineer California & Oregon Power Company.
Davis, W. J., Pacific Coast engineer General Electric Company.
Downing, P. M., engineer hydroelectric operation, Pacific Gas & Electric Company.
Demeritt, Captain **H. L.**, United States Engineer Corps.
Earl, Guy C., vice-president and general counsel Great Western Power Company.
Eckart, Nelson, assistant city engineer, San Francisco.
Egerton, E. O., member California Railway Commission.
Enler, W. G. B. E., superintendent of operation, Great Western Power Company.
Flannagan, E. W., assistant superintendent telegraph, Southern Pacific Company.
Fleishhacker, Mortimer, President Great Western Power Co.
Fleishhacker, Herbert, president Anglo and London-Paris National Bank, and member of Federal Reserve Bank.
Fogalsang, T. E., superintendent of distribution, Great Western Power Company.
Frieze, A. C., of A. C. Frieze & Co., San Francisco.
Galloway, J. D., consulting engineer, San Francisco.
Goodwin, W. L., general sales manager Pacific States Electric Company.
Hall, Chaffee E., assistant general counsel Great Western Power Company.
Halloran, A. H., managing editor "Journal of Electricity, Power and Gas."
Hood, John, local engineer General Electric Company.
Ham, P. W., engineer Great Western Power Company.
Hardie, Carl, city electrical engineer, Oakland.
Harris, Geo. H., general superintendent San Francisco-Oakland Terminal Railways.
Heise, C. E., district manager Westinghouse Electric & Manufacturing Company.
Hoar, F. E., electrical and gas department, California Railroad Commission.
Jollyman, P. J., Pacific Gas & Electric Company.
King, Joseph J., president Chamber of Commerce, Oakland.
Keith, W. W., harbor manager, City of Oakland.
Knott, L. A., general sales manager Standard Underground Cable Company.
Kendall, E. J., claims and right of way agent Great Western Power Company.
Leffler, C. S., assistant to general agent Great Western Power Company.
Koontz, J. A., electrical engineer Great Western Power Co.
Lisberger, S. J., engineer electric distribution, Pacific Gas & Electric Company.
Loveland, H. D., member California Railway Commission.
Long, E. H., district superintendent of plant, The Pacific Telephone & Telegraph Company, Oakland.
L'Hommedieu, W. P., engineer Westinghouse Electric & Manufacturing Company.
Martin, C. R., sales manager Allis-Chalmers Company.
McKay, M. S., San Francisco & Sierra Power Company.
McKee, Paul, California & Oregon Power Company.
Meredith, Wynn, of Sanderson & Porter, engineers.
Messner, L. M., division superintendent of lines, Western Union Telegraph Company.
Mynard, C. E., assistant treasurer Great Western Power Co.
Newman, Jerome, assistant state engineer and chief engineer of Board of State Harbor Commissioners.
Ord, J. L., division superintendent of plant, Western Union Telegraph Company.
Ost, Paul, electrical engineer, City of San Francisco.
Pahl, A. J., K. P. F. Electrical Company, San Francisco.
Patterson, F. C., general sales department, General Electric Co.
Ryan, Professor **H. J.**, professor of electrical engineering, Stanford University.
Rosener, Leland S., consulting engineer, San Francisco.
Rosborough, Jos. J., postmaster, Oakland.
Sachse, Richard, chief engineer California Railway Commission.
Spaulding, W. H., assistant secretary Great Western Power Co.
Smith, Frank W., general purchasing agent Great Western Power Company.
Stevenson, V. V., Postal Telegraph Company.
Smith, E. M., engineer Standard Underground Cable Company.
Sawyer, T., United States Steel Products Company.
Siever, W. H., manager wire products department, United States Steel Products Company.
Teague, W. T., division superintendent of plant, The Pacific Telephone & Telegraph Company.
Thelen, Max, president California Railroad Commission.
Trowbridge, H., Jno. A. Roeblings Sons Co., San Francisco.

Van Norden, R. W., consulting engineer, San Francisco.
 Wilson, C. J., Pacific Gas & Electric Company.
 Webster, Fred, district manager Allis-Chalmers Company.
 Weeks, Geo. K., president San Francisco-Oakland Terminal Rys.
 Woodridge, J. E., Ford, Bacon & Davis, engineers, San Francisco.
 Woodward, F. H., manager Oakland division Great Western Power Company.
 Wyche, T. J., chief engineer Western Pacific Railway Company.

TRADE NOTES.

The Mechanical Installation Company, now located with offices and shop at 181-9 Second street, San Francisco, in need of more room for their work shop, are moving to 115 Main street. Their offices, however, will be located at the same place as formerly. This company has recently installed a large generating unit for the Universal Gas Company.

Keeler White Company, representatives of the Appleton Electric Company and the W. J. Murdock Company, have moved from their old quarters at No. 680 Howard street to No. 221 Second street, San Francisco, with larger and roomier quarters. Mr. White announces that owing to the increased business this was really necessary. The company's present quarters are much more advantageously located than formerly.

The Central Electric Company of San Francisco has moved from 618 Mission street to 175 Jessie street, opposite the Builders' Exchange, into larger quarters. They have added a small stock of retail fixtures to their business. This company has recently secured wiring contracts for the Women's Athletic Club, a four-story building, out of Bliss & Faville's office, also wiring for Congressman Kent's home at Kentfield, and Capital National Bank building at Sacramento.

The Morrison Electric Company, 111 W. Park street, Portland, S. C. Jaggar, manager, has leased and occupied additional space in the Pittock Block location and has established one of the most complete electrical fixture shops in the city there. The old store at 353 E. Burnside street has been closed and the entire stock carried at the W. Park street store and assembling plant, which gives the company unusual facilities for handling all kinds of electrical repairs, contracting fixtures, as well as equipment lines.

H. B. Squires has moved to 583 Howard street, San Francisco, next door to his old location. Mr. Squires finds with an extended line of Cutler Hammer and National India Rubber Company's goods that more room is necessary to meet the growing demand and has secured this fine loft with 8250 square feet floor space to be divided between the two companies mentioned. Mr. Squires announces that he has recently received two carloads of the National India Rubber Company's products. The quarters are commodious, well lighted, with automatic elevator, which makes them easily accessible. Mr. Squires has just left for Seattle and Portland on a business trip.

A new branch office has been established at San Francisco by The Bristol Company at 727 Rialto Bldg., and one of their sales engineers, B. J. Klein, has been appointed Pacific District Manager and will have his headquarters in this new branch office. In connection with the extensive exhibit of Bristol Recording and Indicating instruments, set screws and belt fasteners at the Panama-Pacific Exposition, a great interest in the products manufactured by The Bristol Company was evidenced by customers located in the Pacific Coast territory and the new branch office has been established in order to better serve the interests of these customers. Mr. Klein is a mechanical engineer and instrument expert, having had a long experience with the Bristol Company including a period of more than six years as Chicago district manager, and having been located at San Francisco a year already as manager of The Bristol Company's exhibit at the Exposition.

MEETING NOTICES.

San Francisco Electrical Development and Jovian League.

Arthur E. Rowe presided in characteristically snappy fashion as chairman of the day at the luncheon on March 8th. After a number of good vocal selections he introduced Edward Rainey, secretary to Mayor Rolph, of San Francisco, who gave an interesting talk on the recent improvements in municipal affairs. Great interest is being developed in a rejuvenation which First Tribune Murray Orrick and Second Tribune A. E. Wilcox plan early in May.

San Francisco Engineers' Club.

An enjoyable smoker and pow-wow was held at the club rooms on the evening of March 10th, over one hundred members being in attendance. The feature of the evening was a mock trial, Mr. George Dillman being the defendant. By a series of remarkable legal processes, however, W. W. Briggs, who had been acting as judge, was put on the stand and found guilty of the same offense charged to Mr. Dillman, the latter's case being dismissed. A number of moving pictures, including one on the advantages of electrical farming, were shown through the courtesy of the General Electric Company. Wynn Meredith acted as chairman of the entertainment committee which arranged the programme.

Los Angeles Jovian League.

The attendance at the luncheon Wednesday, March 8th, taxed the capacity of Christopher's large banquet hall to the limit. President Holland wore a broad smile, as did Harry Sessions, editor-in-chief of the "League Bulletin," the breezy weekly reminder, a "drawing card" in itself. R. H. Hess, manager of the Caldalite Company, speaker of the day, introduced Chas. R. Jarvis, Los Angeles representative of the Christian Science "Monitor," who spoke on "Journalism, Its Opportunity and Achievement." In a plea for clean, wholesome journalism, regardless of denomination, he asserted that the crying need of today is the clean newspaper, devoid of all sordid, sensational and criminal news. He traced the growth of the "Monitor" from a small obscure publication in 1908, to its present unique position as the only newspaper in the United States free from provincialism, and with the aim in view to make it the greatest newspaper in the world. A committee consisting of W. J. Gracey, G. E. Arbogast and E. C. Ebert, was appointed by President Holland for the purpose of completing arrangements for an electrical show to be held in conjunction with the "Pure Food" Exposition which opens March 15th. "Some violinist" in the person of Mr. Bourn Jones, dispensed the harmony for the occasion, and his splendid program was heartily applauded.

NEW CATALOGUES.

No. 5 of the Westinghouse Lamp Company's salesmen's lamp handbook series contains arguments and methods of presentation to induce various classes of prospects to replace gas lighting or less efficient forms of electric lighting with Mazda lamps.

Hubbard & Company of Pittsburg have issued a complete catalog of standard pole line hardware and Peirce specialties. The book contains 260 pages, 8½ by 10 inches, and is printed on a suede finish offset paper, with dark green, flexible, paper cover. The 260 pages and 616 illustrations in the book are divided into 16 sections, in each of which material is grouped according to the purpose for which it is used, as, for instance: guying material, crossarms and fittings; high tension arms and fittings; telephone and telegraph wiring; cable material, etc. An abridged listing of Hubbard shovels and track tools is given, together with a description of the manufacture and use of Bates expanded steel poles.



NEWS NOTES



ILLUMINATION.

TACOMA, WASH.—The city is considering ornamental lights for two city parks.

LOS BANOS, CAL.—The board of trustees has awarded a franchise for a gas plant to W. H. Worswick.

BISHOP, CAL.—Harry Tsheppe has plans under way for establishing a plant here to supply gas to Bishop residents.

ALBUQUERQUE, N. M.—A lighting contract for the Y. M. C. A. Building has been let to M. Nash. Work will begin at once.

BAKERFIELD, CAL.—J. F. Endert has secured a contract from T. W. McManus to put in street light standards and lights in Highland Tract.

OAKVILLE, WASH.—The council is considering the purchase of the town lighting plant from Frank Leisner, and operating it as a municipal utility.

LOS ANGELES, CAL.—The city council has adopted the report of the board of public works with reference to the lighting of ornamental posts on various streets.

SANTA BARBARA, CAL.—Ornamental lights are to be placed in the Riviera district, the contract for the work having been awarded to the Reynolds Electric Company.

ORANGE, CAL.—The trustees have approved the contract with the Southern California Edison Company and the new light extension will be completed about April 1st.

BOISE, IDAHO.—The town of Albion has been granted a certificate of public convenience and necessity for the construction and operation of a municipal electric light plant.

LOS ANGELES, CAL.—The board of supervisors has made an order calling an election for the formation of the Graham Lighting District with amended description of boundaries.

HUGHSON, CAL.—Hughson was organized as a lighting district at an election held recently. The proposed plan for lighting contemplates 20 100 watt lights distributed over the district.

HUNTINGTON BEACH, CAL.—An ordinance adopting specifications for the installation of conduits, posts and lights for ornamental street lighting has been passed by the board of trustees.

SANTA ANA, CAL.—Lamps, poles and wire are now on hand and the lighting committee and the Palmer Motor Shop are ready to begin the installation of an ornamental lighting system.

BAKERSFIELD, CAL.—W. E. Drury, chairman of the city improvement committee of the chamber of commerce, has appointed Herman Dumble and W. E. Benz as a committee to take up the matter of street lighting.

SAN BERNARDINO, CAL.—The city clerk has been instructed by the city council to advertise for bids on a five year contract for electric current for the street arc lighting system, as the present contract expires this month.

TACOMA, WASH.—A landslide at La Grande on March 7th seriously damaged the Tacoma municipal power plant, carried away 47 ft. of the tramway back of the powerhouse and piled tons of earth and rock against the building.

FRESNO, CAL.—The trustees have awarded the contract for the installation of 13 standard electrolliers on J street between Merced and Tuolumne streets, and 3 on Tuolumne between I and J streets to the Central State Electric Company for \$1278.

BETTERAVIA, CAL.—The San Joaquin Light & Power Corporation is installing a 2000 kw. steam station here to act as an auxiliary to their hydroelectric transmission. The units are being transferred from the Bakersfield steam plant. This service is being installed to guarantee continuity of service to the sugar refinery which is being completely equipped with electric motors.

TRANSMISSION.

HEMET, CAL.—The Hemet Milling & Power Company has sold its plant to the Southern Sierras Power Company for \$4278. The consolidation will likely be effected by April 1st.

MARYSVILLE, CAL.—The Las Plumas power plant of the Great Western Power Company, which recently completed a 1000 ft. flume, the pipe being 72 in. diameter, is planning to install two similar flumes and two more units at its mountain plant. The work will commence within a few months.

SAN FRANCISCO, CAL.—The engineering department of the Great Western Power Company has completed working drawings for the new class-A substation which will be erected on Bush street west of Grant avenue at a cost of \$100,000. A complete steel frame is specified and figures for the steel work are now being taken. The balance of the work will be let in a general contract.

LOS ANGELES, CAL.—A resolution has been passed by the city council that it is necessary for municipal purposes that permanent easement and right of way be acquired by condemnation for the purpose of constructing and operating electric power transmission lines and telephone lines, extending from a point in Inyo county to a point in Los Angeles county and the city attorney has been authorized to institute proceedings in the superior court for said condemnation, and to prosecute same to final judgment.

TELEPHONE AND TELEGRAPH.

RICHMOND, CAL.—It is announced the Pacific Telephone & Telegraph Company will erect a central exchange building here this year.

HOLTVILLE, CAL.—A contract has been awarded for the erection of a new building for the Imperial Telephone Company, which will be completed within sixty days.

NORTH YAKIMA, WASH.—E. F. Keyes, manager of the Yakima Valley Telephone Company states that arrangements are under way for the construction of a line to Harrah.

AUBURN, CAL.—The city trustees have granted Miss Alfarata Hall of the Placer Telephone Company, permission to use a short distance of pole line in this city that has been abandoned by the Pacific Gas & Electric Company.

CHEHALIS, WASH.—The Independence Telephone Company of the Cowlitz district has practically decided to dispose of the Chehalis-Ethel, Chehalis-Toledo, Toledo-Winlock and Toledo-Ethel telephone lines. The Farmers' Independent association of Salkum has decided to dissolve the association at an early date.

SAN FRANCISCO, CAL.—Architect Willis Polk states that plans are practically completed for the construction of the new Western Union building, which is to be erected on the property of the McCreery Estate at the northeast corner of Montgomery and California streets. The building will be 10 or 12 stories high and of the class A type throughout. The first and second floors, basement and possibly one or two other floors will be occupied by the Western Union. The rest of the building will be arranged for offices.

TRANSPORTATION.

EAST SAN DIEGO, CAL.—The Board of Trustees has awarded a franchise for the extension of the University-avenue car line eight blocks, from Fairmount to Euclid avenue, to the San Diego Electric Railroad Co.

SALEM, ORE.—Surveys are being made for an electric railway from Salem to Bend. The fact that the line is announced to use electric power tends to confirm the belief that the Hill interests are in control of it, as their policy is to electrify their lines where possible.

ALBUQUERQUE, N. M.—George Roslington, president of the City Electric Co., has announced plans for enlarging the company's barns in Old Albuquerque. The company's operating plans contemplate steady increase in business, and every arrangement is being made to meet the growth of the city with complete service.

CORVALLIS, WASH.—Work is beginning on the electrification of the Southern Pacific's west side line from Whiteson to Corvallis. It will be some months before the machinery is delivered, but in the meantime the bonding of rails and erection of overhead wiring will be pushed. The electric sub-stations will be built at Willsdale and at McCoy, under present plans, though this has not been definitely determined.

WATERWORKS.

ALBUQUERQUE, N. M.—An election to decide whether or not the city will bond itself for \$400,000 for a water plant will be held on April 4th.

OTHELLO, WASH.—The time is not far distant when the city of Othello will find it necessary to issue bonds to provide for making repairs to its water system.

MILWAUKEE, ORE.—As the result of a special election held in Milwaukee, the voters authorized the council to issue

bonds of \$5500 to complete the purchase of the Milwaukee Water Co.

EMMETT, IDAHO.—The city council has decided to extend the water mains on Johns avenue to Fourth street, and on De Clark avenue. It will require a carload of piping for this work.

KUNA, IDAHO.—Kuna has voted bonds to the amount of \$16,000 for the construction of a waterworks plant. The supply will be obtained from a deep well and a stand pipe will be erected. Steel pipe will be used in the distributing system.

MADERA, CAL.—A petition for the formation of an irrigation district is to be presented to the Board of Supervisors on April 3rd, the proposed district to comprise about 17,000 acres. It is proposed to secure water by pumping from the wells near San Joaquin River, the pumps to be operated by electric power.

SEATTLE, WASH.—The utilities committee of the city council has gone on record as favoring a water utility bond issue of \$50,000 for establishing a water stand pipe and pumping station at the Maple Leaf reservoir. The stand pipe and pumping station and the necessary feeder mains will cost \$50,000. The mains and hydrants in the district will cost \$80,000, of which property owners will be required to pay \$70,000.

BUHL, IDAHO.—At a meeting of citizens of Buhl to determine the advisability of pumping water up from Clear Lake, a majority expressed themselves as favoring the project, providing it can be done without increasing the water rate more than 50 per cent. Captain Hazzard and Councilman Koppelman favored the Clear Lake water system. A hydraulic engineer of Pocatello estimated that a system of 300,000 gallons per 24 hours capacity could be built for \$50,000, and a plant four times as large be built for \$90,000. The city council will make further investigations.

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STEEL CAR FORGE CO.
Steel Forgings for Railway Work

UNITED STATES STEEL PRODUCTS CO.
(American Bridge Company.)
Steel Poles and Towers for Transmission Lines

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Bare and Insulated Aluminum Wire and Cable

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BRIDGEPORT BRASS CO.
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| H-5 | Hunt, Mirk & Co.....
141 Second St., San Francisco. | W-2 | Western Electric Co.....
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FEASIBILITY OF WESTERN ELECTRO-METALLURGY.

BY DORSEY A. LYON AND ROBERT M. KEENEY.

ELECTRIC IRRIGATION PUMPING IN IDAHO.

BY W. T. WALLACE.

IDAHO PHOSPHATE RESOURCES.

BY R. N. BELL.

THE EMPLOYEES' OBLIGATION.

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FEASIBILITY OF WESTERN ELECTRO-METALLURGY

BY DORSEY A. LYON AND ROBERT M. KEENEY.

(This comprehensive summary of the status of the application of electricity to metallurgy constitutes Appendix J of the Columbia River Power Project Report, having special reference to the feasibility of employing the power to be developed at The Dalles, Oregon, for electrometallurgical work. Mr. Lyon is metallurgist with the U. S. Bureau of Mines and Mr. Keeney metallurgical engineer at Cornucopia, Ore.—The Editor.)

Introduction.

Utilization of hydroelectric power in electro-metallurgical industries may be of two kinds. The electric energy may be used to supply the heat necessary for the performance of the chemical reactions of a metallurgical process, or the electrolytic action of

of a patent. That is, we consider electro-metallurgical industries as commercial operations which are now consuming large blocks of electric energy, while processes, which are not in commercial operation, are only prospective consumers. Also, owing to the difficulty and chance connected with any attempt to fore-



Dam Site for Proposed Columbia River Power Development.

a direct current may be employed for extraction of metals either in a reduction process or a refining process. For the purposes of this report, which are commercial, it is well to distinguish between established industries, which are producing metals and alloys at a profit by use of the electric current, and the many processes which are either still in the experimental stage or have not even passed the paper development

see the effect of the European war upon electro-metallurgical industries, we have felt obliged to disregard the war entirely and state our opinions regardless of the existence.

Disregarding electrolytic refining processes, the applications of electric energy to metallurgy, when considered from a commercial viewpoint, may be classified as follows:

Industries.

Manufacture of aluminum.
 Electric furnace manufacture of ferro-alloys.
 Manufacture of pig iron in the electric furnace.
 Manufacture of steel in the electric furnace.

Experimental Processes.

Electric furnace smelting of copper ore.
 Electric furnace smelting of zinc ore.

In this report only the above industries and experimental processes will be considered as possible consumers of hydroelectric power in large quantities. Electrolytic refining processes are not classified above, as they are either so closely interwoven into a cycle of metallurgical operations as one single step as to prohibit their operation as a separate industry, or the electrolytic process is of such a small scale operation as to be unimportant as a large consumer of power. An example of the former is electrolytic refining of copper. As at present operated, the electrolytic copper refinery, while it may not be located at the copper smelter, is usually owned by a smelting company upon which it largely depends for its supply of unrefined anode copper. It has also been found advantageous to locate copper refineries near the market for refined copper, which is New York. An extreme illustration of a small scale electrolytic operation which is not worth considering as a large consumer of power is electrolytic refining of gold and silver. All of the above electro-metallurgical industries are adaptable to self-contained development in a single plant, under proper conditions. Practically none of these industries consume less than 1000 horsepower in a single installation. There are many electro-metallurgical processes in successful use for the extraction or refining of metals which do not consume large amounts of power, because the yearly yield is small, as in the case of gold and silver, or, production is reduced by the small market, for example, calcium, magnesium or bismuth. If there was a demand for them, the two former metals might be produced profitably in conjunction with the manufacture of sodium, which, while a larger consumer of power than either calcium or magnesium, is not a large consumer in comparison with other electro-metallurgical industries.

There are many electro-metallurgical processes which might be considered as possible consumers of power, but in the majority of cases they exist only in patent specifications, and with a very few exceptions have not been extensively tested by either small or large experimental work. As an immediate market for power, most of these processes are of no interest to the power producer.

Factors influencing the success of an electro-metallurgical industry. The commercial success of an electric furnace or electrolytic industry, in which the basic process employed is technically sound, may depend largely upon the following factors:

1. The market for the product;
2. The cost of electric power;
3. Freight rates;
4. Labor conditions;
5. Cost of raw materials.

Of these factors, all except the cost of electric power will influence the success of any manufacturing project to a considerable degree.

Market for the product is of equal importance to the cost of power, for if there is not a steady market for the product, permitting a profit on the investment, a low cost of power will not necessarily result in the ultimate success of the enterprise. There is only a limited market for many electro-metallurgical products, so that while a good profit might be made on paper by comparing the cost of production with the average selling price the enterprise would be a failure with a large part of its products unsold. Where market competition is strong, success, as in any line of business, would depend to a large extent upon the efficiency of operation, quality of the product, and the ability to sell the product at as low a price as any manufacturer.

Among many persons the idea prevails that the success of an electro-metallurgical enterprise depends almost entirely upon a low cost of electric power, but as previously stated, we believe that a strong market demand for the product is of equal importance to the low power rate. In general it is true that reduction processes require a very low power cost, especially operations producing a large tonnage of a comparatively cheap product which compete with combustion processes, as, for example, electric smelting of iron ore and zinc ore. On the other hand, electric furnace refining processes do not require an extremely low power cost to attain commercial success, as many electric steel furnaces are operated at a profit on a power cost of 1 cent per kilowatt hour or \$65.70 per horsepower year. Few electric furnace reduction processes can operate successfully with a power cost of over 0.30 cents per kilowatt hour or \$20 per horsepower year, and to be greatly assured of commercial success require a power cost of \$10 to \$15 per horsepower year. We wish to emphasize again the statement that the commercial success of an electro-metallurgical enterprise does not depend entirely upon the cost of power.

Freight rates have a large influence on the success of such a project, and in general it may be stated that in the western part of the United States no electro-metallurgical enterprise producing a tonnage product would stand much chance of success unless it was located within a few hundred miles of the sea coast, because of the high freight rates prevailing in the west as compared with eastern rates. The short distance to water shipment has been a large factor in the success of Norwegian and Swedish electro-metallurgical plants, as well as the works in Switzerland and the French Alps. Practically all of their product is exported to foreign countries by water, while most of their ore and coal or coke is shipped to them by sea. With the exception of an electro-metallurgical plant located to utilize some specific raw material near by, the cost of raw material will depend largely upon freight rates, for, in the majority of cases at least, the ores used must be brought from a distance.

Aluminum. The development of the present aluminum industry began in 1886 with the discovery by Hall that aluminum dissolved in a molten mixture of aluminum fluoride and the fluoride of another metal

forms an electrolyte, which may be decomposed by the electric current, giving aluminum at the cathode and oxygen at the anode. In 1887 Heroult of France patented a similar process, it being a case of simultaneous invention. The matter was settled by the company controlling the Hall patents taking the American field while the Heroult patents were used exclusively in Europe.

Previous to that time the small amount of aluminum made was produced by reduction of the halide salts of aluminum with metallic sodium. Reduction of alumina to aluminum with carbon is not practical, because it is necessary to let the aluminum form an alloy with some other metal, such as copper, to prevent the formation of aluminum carbide.

The remarkable growth of the aluminum industry in the United States is shown by the table of production in the United States, 1883 to 1913.

Production in Pounds of Aluminum in the United States, 1883-1913.*

1883.....	83	1894.....	550,000	1905.....	11,347,000
1884.....	150	1895.....	920,000	1906.....	14,910,000
1885.....	283	1896.....	1,300,000	1907.....	17,211,000
1886.....	3,000	1897.....	4,000,000	1908.....	11,152,000
1887.....	18,000	1898.....	5,200,000	1909.....	34,210,000
1888.....	19,000	1899.....	6,500,000	1910.....	47,734,000
1889.....	47,468	1900.....	7,150,000	1911.....	46,125,000
1890.....	61,281	1901.....	7,150,000	1912.....	65,607,000
1891.....	150,000	1902.....	7,300,000	1913.....	72,379,000
1892.....	259,885	1903.....	7,500,000		
1893.....	333,629	1904.....	8,600,000	Total.....	377,737,779

Ferro-alloys. Up to the year 1899, when the electric furnace was first used in the manufacture of ferro-alloys, all ferro-alloys were made in the blast furnace or the crucible furnace. High percentage ferromanganese was first produced at Bonn, Germany, in 1866. The crucible furnace was used for the purpose. The manufacture of ferromanganese was first conducted in the blast furnace in 1873, and at the present time practically all of the ferromanganese used in the steel industry is made in the blast furnace. In 1875 ferrosilicon containing 10 to 12 per cent silicon was made in the blast furnace. The manufacture of ferrochrome in a commercial way in the blast furnace started in 1886. Thus up to the year 1890 all ferro-alloys were made in combustion furnaces. In the blast furnace ferromanganese containing 80 per cent manganese can be readily made, but ferrosilicon produced in this way seldom contains over 12 per cent silicon, while the ferrochrome carries 30 to 40 per cent chromium.

The opportunity for improvement in the production of high grade ferro-alloys by the use of the electric furnace was made evident by the researches of Moissan, beginning in 1890, upon the reduction of metallic oxides in the electric furnace.

The commercial production of ferro-alloys in the electric furnace began in 1899 when the Bullier patents for the manufacture of calcium carbide were declared valid in France. There was also an overproduction of calcium carbide which culminated at the same time. This rendered it necessary for many established carbide works to seek new uses for their electric power and their electric furnace installations. These works began the manufacture of ferrosilicon, ferrochrome and ferromanganese in the old carbide furnaces. At that time the manufacture of ferromanganese in the elec-

tric furnace did not prove successful because of the high loss of volatilization. The production of high percentage ferrosilicon, ferrochrome and other ferro-alloys not easily volatilized was very successful.

By 1902 ferrosilicon containing 25 per cent silicon was being made in the electric furnace, and this alloy was used to a considerable extent by steel manufacturers instead of the blast furnace alloy of 10 to 12 per cent silicon. This was quickly followed by the introduction of ferrosilicon containing 50 per cent silicon. The high grade ferrochrome of 60 to 70 per cent chromium and 5 to 8 per cent carbon rapidly replaced in use the lower grade blast furnace product. Later the production of ferrochrome containing less than 1 per cent carbon was begun. As the refining possibilities and the high temperature available were more fully understood, the production of many ferro-alloys not previously manufactured was commenced.

Pig Iron. In 1898 E. Stassano of Italy experimented upon the production of steel directly from ore in the electric furnace. At about the same time other ores were being reduced in the electric furnace in the manufacture of ferro-alloys. As a result of this work, the attention of the Canadian Government was directed to the manufacture of pig iron in the electric furnace. Canada is not as well favored as the United States with abundant high grade iron ore and first class coking coal. Ultimately, through the efforts of Dr. Haanel, a commission was appointed in 1904 to investigate the different electrothermic processes employed in the smelting of iron ores and the manufacture of steel then in operation in Europe.

While the commission was at La Praz, France, Dr. Heroult demonstrated the possibility of production of pig iron from iron ore in the electric furnace. At the plant of Keller, Leleux & Co., Livet, France, further experiments were made on a larger scale. These experiments made at Livet in 1904 marked the real beginning of the present practice of reduction of iron ores in the electric furnace, for, although the furnaces in use for this purpose at present differ considerably in construction from the Keller furnace, the principle employed is the same, namely, the ore, flux and reducing agent were fed around the electrodes and the heat generated by the current passing through the charge raises the temperature of the ore and fluxes to their melting point and thus enables the carbon to reduce the ore with which it is mixed.

From the report of the commission it was evident that further work was necessary to determine the consumption of the electrical energy and electrodes, the character of ores which could be used for the production of a good grade of pig iron, and whether peat coke could be used in place of charcoal or metallurgical coke. A furnace was then built at Sault St. Marie, Ontario, and experimental work conducted for several weeks in 1906. The results of these runs showed that magnetite ores of high sulphur content could be made into a good grade of pig iron in the electric furnace; that a low grade of charcoal could be used; that peat coke could be substituted for metallurgical coke; and that titaniferous ores containing up to 5 per cent titanium could be used for the production of pig iron of marketable grade in the electric furnace. No electric furnace pig iron plants are now in operation in Canada, although one was started at

*The production of bauxite and aluminum in 1913. Mineral Resources of the U. S., 1913. U. S. Geological Survey, W. C. Phalen, p. 16.

Welland, Ontario, which was later converted into a ferrosilicon plant. This lack of plants is not, however, due to the technical or commercial failure of electric furnace reduction of iron ores, but because the economic and geographic conditions have not seemed to warrant, to the present time, the introduction of the electric furnace for the production of pig iron.

In Sweden the conditions are somewhat analogous to those found in Canada; that is, there are iron ores but no coal for coking. There is, however, this difference between the conditions in Canada and in Sweden—in Sweden, as also in California, the ores are for the most part high in their iron content and rather free from impurities. The iron industry has been established in Sweden for some hundreds of years. The ores have been smelted in a blast furnace, charcoal being used for the most part as a reducing agent, and Swedish charcoal iron is well known for its purity. For some time it has been apparent to those familiar with the situation that there would have to be some innovation in order to enable Swedish iron manufacturers to keep the cost of production down, due to the scarcity of charcoal at a reasonable price. This fact has resulted in the introduction of electric smelting in Sweden.

Some small scale experimental work resulted in larger scale work being done at the Domnarfvet Iron Works in 1907. After building several furnaces one worked successfully, and it is the forerunner of the present type of Swedish iron smelting furnace. The experimental runs conducted at Domnarfvet satisfied those interested in the work so well that it was decided to go a step farther and to construct and perfect a furnace of a size suitable for commercial purposes. This work was undertaken by the Jern-Konteret, an association of the iron masters of Sweden. This association voted \$90,000 for the purpose of erecting a plant and developing the process at Trollhattan, where the Swedish government also assisted to the extent of furnishing the power at a nominal figure. Operations with this furnace were started November 15, 1910, and were continued without interruption until May 29, 1911. During these experiments the furnace smelted well from the start on various grades of ore. The furnace after some alterations was again put in operation in August, 1911, and was in continuous operation to July, 1912. As a result of the successful working of this plant, it was leased in September, 1912, to the Stromenas Iron Works which has since worked it as a commercial plant.

Simultaneously with the Swedish development of electric iron ore smelting, experimental work was conducted at Heroult, California, by the Noble Electric Steel Company under the direction of Dr. Heroult. The first furnace constructed and operated in July, 1907, appeared to be impracticable because of mechanical difficulties. A second furnace was then constructed, which was similar to the Swedish type of electric furnace, but was developed independently. This furnace proved very successful for the production of white iron, as was also the case at Trollhattan, but high carbon foundry iron could not be made. In the spring of 1911 the company decided to build a new type of furnace. Accordingly, the present type of California furnace was evolved, which has successfully

produced the grade of foundry iron required by the Pacific Coast foundries, an iron high in graphitic carbon and silicon and low in other impurities.

The types of furnaces which have been developed in Sweden and California as at present constructed may be briefly distinguished by the fact that the Swedish type is of circular cross section and has a shaft, while the California furnace is of the rectangular cross section with no shaft. A furnace similar to the present type of California furnace had been previously developed in Europe by calcium carbide manufacturers, and there is now one large installation for smelting iron ore in Sweden.

(To be continued.)

SAN DIEGO COMPANY'S STOCK OFFERED LOCALLY.

Following the new policy of the Byllesby utility companies of encouraging investment by citizens of the community served, the San Diego Consolidated Gas & Electric Company is offering its new issue of \$500,000 7 per cent preferred stock direct to the people of that city. The San Diego Company is a subsidiary of the Standard Gas & Electric Company, and has had a rapid and successful growth. Subscriptions for the new preferred stock issue are being received subject to the approval of the issue by the railroad commission of California. Proceeds will be used to retire \$356,000 6 per cent debenture bonds due in 1922, to pay floating indebtedness, and to provide capital for extensions. The company's present capitalization consists of \$4,266,000 first mortgage 5 per cent bonds due in 1939, \$356,000 6 per cent debenture bonds due in 1922, and \$2,955,000 common stock. The company serves 19,028 electric light and power customers and 21,462 gas customers. Its connected power load is 17,089 horsepower.

The preferred stock is being offered direct to the people of San Diego in a series of newspaper advertisements, in which the fact is brought out that the company has no difficulty in financing its requirements in the general investment markets of the country, but prefers to build up and increase home proprietorship, prefers to build up and increase home proprietorship.

The "nu" is a new unit of measurement suggested by the "Practical Engineer" as a means of reconciling the English and metric systems. It harmonizes both systems, permits of subdivisions and calculation in its own decimal units and easy conversion to either system. The proposed standard of length is 5 ft. or 60 in. It is equal to 1.524 meters; to 152.4 centimeters. This conversion factor is divisible by 2, 3 and 4, and the length in inches, 60, is divisible by 2, 3, 4, 5 and 10. While the multipliers for conversion to metric measurements look irregular, they are exact in 3 places and are immeasurably simpler than conversion from yards or feet or inches to metric units. Going to larger measurements, the mile is 1056 nu. If a greater unit or gu. be taken, as 1000 nu., or 5000 ft., it will equal 1524 meters or 1.524 km., so that the same conversion multipliers will hold between the gu. and the kilometer as between the nu. and the meter.

ELECTRIC IRRIGATION PUMPING IN IDAHO.

By W. T. Wallace.

(Concluded.)

Use of water. It is of particular importance that the best use be made of the pumped water furnished the average pumping irrigation district. The duty of water can be greatly increased by the rotation of water among the users and by the proper selection of crops. For instance, a farmer with a 40 acre tract may have 20 inches of water at his disposal. Such an amount is too small for practical irrigation. He should have the use of two to four times this flow until his irrigation is finished, after which his water can be turned over to his neighbors who in turn will have the benefit of a practical working flow. A great waste of water occurs in many localities from the use of a flow that is entirely too small for securing economical results. Water is often allowed to run too far over the land. In many cases fields are watered for a quarter of a mile between the supply ditches. This results in an excessive watering of the upper parts of such a field, which is a great waste and often a positive detriment to the crop. The remedy lies in using a sufficient head of water to cover the land quickly and in flooding over the surface of the land for a short distance only.

An excessive acreage of alfalfa complicates the water question as it requires about twice as much water as the average crop. Corn will produce 10 to 12 tons of ensilage per acre, worth about \$4.00 per ton, and requiring only an average amount of water. Corn ensilage fed with alfalfa makes a better balanced ration than alfalfa alone.

Water storage. Under ordinary conditions in this section it is advisable to have an additional supply of water for two months during the hottest of the season. While this water peak may be somewhat reduced by proper crops, water rotation and best methods of irrigation, it is difficult to avoid it entirely. It is extravagant to install additional pumping equipment for meeting this peak, as this increases the cost for power in greater proportion than the water pumped. Sometimes it is possible to provide storage water for this purpose.

The power rates given are applicable for use during the entire year. It may be advantageous to store water by pumping throughout the year, which could be used for supplying this peak demand. Suppose the system has several lifts. It might be advisable to have a storage reservoir under the higher lift which could be filled during the winter months and which would result in economy, although a certain percentage of the stored water would be lost by seepage and evaporation before the time for its use had arrived. In some cases it might be profitable to install special pumping equipment where a suitable storage site is available at a moderate increase in elevation above the higher lift. This winter storage of water is a most important point and one deserving careful consideration in laying out a pumping project. Where water is pumped to any considerable height, say from 75 to 100 ft., seepage losses assume especial importance. It is nothing unusual for a canal system to lose as much as 40 per cent of the water received at the head of the canals. Consider, for instance, a pumping plant draw-

ing a maximum of 2500 electrical horsepower. The minimum bill on such a plant for a six months' season is \$45,000. Assuming a 40 per cent seepage loss, the waste power from this source costs \$18,000 per season. This is 8 per cent on a principal of \$225,000. The cost of good concrete lining for a 100 second foot canal varies from \$2 to \$3 per lineal foot, depending on the canal section, price of materials, etc. Fourteen to twenty-one miles of such canal could be lined with this principal. While it will be impossible to prevent all seepage by lining the main canals, still this comparison shows the folly of putting expensive pumped water into ditches in poor condition. The necessity for cutting down seepage losses increases directly with the head pumped.

Requirements for Successful Pumping.

One of the fundamental differences between gravity and pumping systems is the annual cost of operation. A large gravity system is usually completed and turned over to the settlers, presumably in condition for furnishing a full water supply. The total cost lies against the land for which the system is provided and arrangements are usually made for taking up this construction charge in a long series of small payments, the first as a rule not falling due for some years. The total annual charge per acre for the first few years is interest on the bonded indebtedness plus a moderate maintenance fee, averaging from \$1.00 to \$1.50 per acre. Under such a system, a land owner may hold idle land for several years without being greatly burdened. The farmers who begin at once the reclaiming of their lands are furnished all of the regular water allowance and oftentimes a surplus which aids greatly in subduing raw land. The irrigation system can be operated at full capacity for practically the same cost as for partial capacity.

The pumping system, however, is subject to more severe requirements in its early years. It is impracticable to water a small percentage of the total lands scattered over the district with the same pumping charge per acre irrigated as would be necessary for watering the whole tract. This is due to the fact that seepage losses for most of the system must be supplied, although but a fraction of the water is delivered, and to the fact that the pumps working at less than their full capacity must be throttled down, which lessens their efficiency considerably. Consequently, the average pumping plant watering only a third of the land in scattered sections will require a power consumption out of all proportion to the acreage watered. This results in a heavy pumping charge falling on the idle lands which accumulates rapidly and makes it imperative that such lands begin immediately to produce returns to offset such charges. The irrigation pumping district is no proper field for a land speculator. It is important that most of the lands under pumping system should be cultivated immediately if such a project is to be successful.

Lift. Most pumping districts have several lifts in order to prevent excessive power charges. This adds to the cost of the irrigation system and greatly increases the seepage losses. A careful study and very good judgment are necessary to determine how many lifts are profitable. The total average lift in the present state of the land market should not exceed 75 to

80 ft. for large districts and should be proportionately less for small tracts, providing that the land is to be used for general farming. Some Idaho irrigation projects have been condemned at the outset by excessive lifts undertaken.

In order to make a rough comparison between the value of raw land under gravity systems and under pumping systems of various heads, suppose that the annual maintenance cost per acre is \$1.25 for the gravity system and \$1.50 for the pumping system; that the average cost of gravity system per acre is \$30 and for pumping systems is \$20; that all annual charges for water represent a principal at 9 per cent on the basis of interest at 8 per cent and taxes and insurance at 1 per cent; that the pumping system delivers $\frac{5}{8}$ in. per acre at the pumps with an efficiency of 75 per cent based on the total head, that power is received at the minimum price of \$18 per horsepower for a six months' season; and that general improvements are worth \$30 per acre under both systems. These assumptions give the benefit of all doubt to the pumping system. Then, if improved land is worth \$100 per acre, raw land has the following values:

Gravity System		\$26 per acre
Pumping System: Total Head.....	25 ft.	24 per acre
	50 ft.	18 per acre
	75 ft.	5 per acre
	100 ft.	Minus 4 per acre
	125 ft.	" 14 per acre
	150 ft.	" 23 per acre
	175 ft.	" 33 per acre
	200 ft.	" 42 per acre

Pumping plant. The pumping plant should be designed to operate at full capacity 24 hours per day throughout the season in order to take advantage of the low power rate for such service. As previously mentioned, in connection with power rates, the advantage to the consumer of such use is great. There is opportunity for improvement in the type of motors employed. Formerly all pumping motors have been induction type having the average commercial efficiencies, which are fair for large size and high speeds, but which are low for slow speeds. The induction motor is not as efficient as the synchronous motor for sizes exceeding 100 h.p. and is at a greater disadvantage on the low speeds necessary for low lifts.

Synchronous motors have now been developed to a point where they are practically as fool proof and as satisfactory in operation as the standard induction motors. For instance, in one Idaho plant two synchronous motors were recently installed, one of 152 h.p., the other of 256 h.p., having efficiencies at full load of 94.7 per cent and 95.5 per cent respectively. The standard induction motor of the same size and speed has efficiencies of 89 per cent and 91 per cent respectively. The synchronous motor is not suitable unless an operator is in constant attendance. For large pumping plants this feature is not a drawback. The first cost of synchronous motors is slightly higher, but the saving in power consumption will pay the excess cost within two or three seasons.

Pumps. Too careful attention cannot be given to the selection of proper pumps. The centrifugal type is the standard for all lifts that are feasible in this territory. The pump as a machine should be of high grade, have renewable wearing parts, and be of such construction throughout as to maintain a high permanent efficiency at reasonable cost for renewals. It is impossible to secure any centrifugal

pump which will maintain a high efficiency indefinitely. The best of runners will wear and fairly frequent replacement should be anticipated. Under ordinary conditions it is advisable to use bronze impellers, as pumps are not given the attention necessary to maintain a good efficiency with cast iron impellers. A mistake is often made in purchasing bronze impellers without specifying the composition of the bronze. The price of bronze varies according to its composition. The manufacturer may take advantage of a loose specification to supply an inferior grade. Probably standard government bronze of 88 per cent copper, 10 per cent tin and 2 per cent zinc is the most efficient material for bronze impellers.

It is vital not only that a high class pump be selected, but that it shall be suited to the conditions under which it is to operate. A pump of perfect design and construction may be abused by using under a head and at a speed for which it is unsuited, resulting in poor efficiency, and rapid cutting of the impellers. Perhaps the greatest abuse of pumps is in connection with small individual plants where no expert advice is obtained before the equipment is purchased. Plants are too often installed without accurate data as to the total effective head and other conditions are not considered which must be taken account of in securing an efficient plant.

A great advance has been made in the design of centrifugal pumps within the past three years. Manufacturers are placing a better grade of small stock pumps on the market. At present it is possible to secure such pumps with guaranteed efficiencies as high as 54 per cent for 2 inch, 62 per cent for 3 inch, 64 per cent for 4 inch, 73 per cent for 6 inch, 74 per cent for 8 inch, and 76 per cent for 10 inch.

All piping should be of ample size and all angles of long radius and as few as possible. Foot valves and all unnecessary fittings should be eliminated. If the discharge line is long it is very poor economy to assume a large friction head for the sake of a slight saving in cost of pipe.

Canal system. The canal system should be as short as possible with the number of lifts selected to insure the greatest economy. The seepage losses from numerous canals should be balanced against the extra cost of pumping into fewer canals of larger capacity with a slightly increased average lift. Liberal use of metal flumes and pipe lines should be made to avoid long detours, which add to the seepage loss and increase the pumping head. The advisability of lining the canals should be carefully studied. In many systems the saving in seepage losses would pay a handsome return on the cost of such lining especially in the larger sections of the main canals. It is poor economy to attempt to save pumping head by adopting too flat a grade for the canals. Very low velocities cause canals to become choked with silt and excessive growth of weeds which limits materially their capacity and adds greatly to the seepage loss. The additional first cost of excavating such canals is also a serious item.

Preliminary plans should be carefully drawn and a minute study made of the entire situation. The aid of a competent engineer and of a soil expert should be secured. Complete estimates of first cost and the

cost of maintenance should be made and checked with the experience of similar districts. Such results should be studied with regard to land values and probable value of crop products.

Operation. Many of our most important pumping systems, some costing over three quarters of a million dollars are turned over to the farmers for operation, none of whom may be experienced in handling a large power plant and who are skeptical as to the need of skilled attendance. The machinery is given improper attention and soon falls off in efficiency. No records are kept as to the water pumped, so that it is impossible to check the efficiencies of the plants as time goes by. No adequate accounting system is used and the cost of operating the plants and maintaining the canal system is unknown. It is wasteful to operate a property of such value under any but strictly business principles.

In private business such methods would soon end in disaster. It is not surprising that some irrigation pumping districts have made unwise expenditures and find themselves in curious situations because of ignorance as to their operating conditions.

Position of Consulting Engineers.

In no field is there an opportunity for a consulting engineer to render his clients greater service than in connection with irrigation pumping projects. While the rough investigations and calculations necessary to determine as to whether a project is feasible, are quickly and simply made, no one, as a rule, makes such estimates without the assistance of an engineer. Too often the system's main features are decided upon without the advice of the engineer and his task is to make the best of a poor proposition. Candid advice on the part of a consulting engineer early in the procedure would often prevent serious fundamental errors.

Great pressure is often brought to bear on a designing engineer to reduce the first cost by every means possible. This results in poor economy in the long run and sometimes in disaster for the project. The engineer must often give advice which may be against his temporary interests but which will result in advancing the interests of the profession permanently. Nothing would be of greater value to this state than to have all its irrigation projects well chosen and well constructed.

Gasoline from shale in Colorado is being investigated by the U. S. Geological Survey, which estimates that in that state alone there is sufficient shale, in beds 3 ft. or more thick, to yield 20,000,000,000 barrels of crude oil from which at least 2,000,000,000 barrels of gasoline may be extracted by ordinary refining processes. The area that has been studied by the Geological Survey comprises northwestern Colorado, northeastern Utah, and southwestern Wyoming. The shale found there contains materials which, when heated, may be converted into crude oil, gas and ammonia. Sooner or later this great source of supply will be utilized to supplement the decreasing production from the regular oil fields. When refined by ordinary methods the shale oil yields an average of about 10 per cent gasoline, 35 per cent kerosene, and a large amount of paraffin.

IDAHO PHOSPHATE RESOURCES.

BY R. N. BELL.

(Details are here given of the fertilizer resources of Idaho and Montana, the paper having been presented before the seventh annual convention of the Idaho Society of Engineers at Burley, Idaho, Feb. 22, 1916. The author is state inspector of mines.—The Editor.)

The phosphate deposits of southeastern Idaho were first recognized as such about twelve years ago as the result of an advertising campaign by the officials of a prominent California smelting company, who, through the harassment of smelter smoke troubles with the local agricultural interests, was forced to reduce its sulphur fumes to sulphuric acid and in an effort to find a market for its acid production, endeavored to discover a local supply of rock phosphate, the treatment of which in the production of superphosphate, involves a heavy consumption of sulphuric acid. The result of this advertising campaign by this company brought specimens to their works of what proved to be high grade rock phosphate from northern Utah and southeastern Idaho. The best Idaho discoveries were made in Bear Lake county in the vicinity of Paris and Montpelier.

The results of these discoveries and the subsequent development and study of the field that has since ensued, has been to give to Idaho and the United States at large, what is probably the most valuable and most important mineral discovery ever made in the nation's history, as this phosphate field has proven to be of enormous extent and capacity, affording what is probably an exhaustless supply of the most vital element of soil fertility that puts this nation in an independent position of foreign source of supply for all time.

Prior to these western discoveries the total known resource of rock phosphate in the United States was largely confined to the states of Florida and Tennessee and was estimated by government geologists as having a probable life of thirty to forty years. These southeastern deposits are largely owned by foreign capital and ship more than a million tons a year of high grade rock to European markets. This situation proved of vital concern to the United States conservation advocates and there isn't any question but that they were justified in their anxiety for the future of American agriculture in this connection and they went so far as to suggest that this government put an export duty on shipments of rock phosphate from this country, but, since the western discoveries have been made and their enormous extent has been outlined, this concern of the conservationists should be dispelled.

High grade rock phosphate has a spot value at the point of production of four or five dollars per ton. The purpose for which it is used is as a fertilizer for soil and its value for that purpose will be appreciated from the following explanation. This mineral is more valuable than coal or iron, or any other substance, by reason of its primary scarcity and its essential necessity to all living organisms, and in this connection I cannot do better than to give you an appreciation of the inestimable worth of this mineral than to quote from a work entitled "The Conservation of Natural Resources in the United States" by Charles R. Van Hise, which is in part as follows:

"The last of the elements which we need to consider is phosphorus, just as we find in the arid regions that water is a crucial factor limiting production, so for the humid regions of the United States, phosphorus is the crucial limiting factor in the productivity of the soil." "Phosphorus is an essential constituent of blood and flesh and bone and brain." How essential it is has been very clearly shown by experiments which have been carried on in the Wisconsin Experiment Station following somewhat analogous experiments elsewhere. Animals have been fed with a ration deficient in phosphate with the result that these animals thrive for a time but after three months they collapse. In an intermittent stage some of them were killed and it was found that the flesh was taking the phosphate from the bone in order to supply its need. This went on until the bones were no longer able to supply phosphorus to the flesh, then the irretrievable collapse came. They could not recover when fed on normal rations."

The soil is the most vital asset of this nation, as from it all our food and clothing is derived. There are about a dozen important constituents in normal soil that supply the elements of plant growth. Most of these, however, are of minor importance and of an exhaustless nature. The three vital elements of plant food are potassium, nitrogen and phosphorus.

Mr. Cyril G. Hopkins, of the University of Illinois, one of the ablest practical soil experts in the United States, has shown that on a general average the primary virgin soils of the United States contain thirty thousand pounds of potassium, about five thousand pounds of nitrogen and about eleven hundred pounds of phosphorus in two million pounds of soil representing an acre surface to a plow shear depth of six and three quarter inches.

The normal supply of potassium is practically exhaustless in the soil. The nitrogen gives way rapidly to crop production but is four times greater in amount than the phosphorus. It is also very cheaply and easily replaced by the cultivation of legumene plants. The phosphorus, in its limited primary amount, is also rapidly used up by growing plants, especially the seed producing plants, such as wheat, corn and other grains, and the crop producing capacity of the soil is permanently reduced by the depletion of its phosphorus contents and the only possible way to supply this deficiency is to physically put back the phosphates in concentrated form upon the land. The exhaustion of this vital soluble salt of vegetation by single and constant cropping without refertilizing has resulted in the agricultural abandonment of millions of acres of formerly fertile land in the original thirteen states and this deterioration in crop producing capacity is rapidly extending westward has crossed the Mississippi River a long distance in some directions.

Hence, it will be appreciated that our rich western field of highly concentrated phosphate mineral must soon find a rapidly expanding market in the prairie states of the middle west, to which it is geographically as conveniently located as are the present sources of supply in the southeastern states.

The American farmer does a great deal of boasting about the wonderful annual crop production that is made, but as a matter of fact on the average he is a soil pirate and robber who gives little regard to the fact that he is living on his principal and rapidly deteriorating the basic value of his land. This fact is illustrated by the experience of European agriculture. The United States census records will show that the

average acre yield of wheat for the past thirty years in the United States will not exceed fourteen bushels per acre and all other grains in proportion, and this in spite of the fact that during that period, hundreds of millions of acres of virgin soil has been put under the plow.

On the other hand in several European countries, under less favorable climatic conditions, the acre yield of grain where intelligent regard for proper soil fertilization is in force, exceeds the United States' average by from one hundred to two hundred per cent. These facts present a big subject for the serious consideration of our National Department of Agriculture, as there isn't any question that by intelligent regard for the renewal and conservation of soil fertility, the total agricultural production of this nation can be doubled from the present cultivated area, a result that would materially reduce the present cost of living and multiply by several times, the basic value of rural credits and is a consummation devotedly to be wished.

The Idaho phosphate deposits resemble coal veins. They occur in a series of shales and thin bedded lime stones of middle carboniferous age. The phosphate series proper is from sixty to two hundred feet thick and is overlaid by heavy bedded limestone formations and underlaid by heavy bedded limestone and sandstone formations. The phosphate series and the immediately overlying formations are readily identified by a conspicuous association of fossil shells and can be followed by reason of these identification marks, through hundreds of miles of duplicated outcrops by reason of the folded and faulted condition of the beds in a mountain region forty miles broad, east and west, by one hundred and forty miles long, north and south, covering a large portion of six of the southeastern Idaho counties, extending from Bear Lake to Fremont.

The deposits occur as beds or veins standing at all angles in the formation from flat to vertical. The outcrops present a brown shaly blossom but at a short distance under ground the mineral is black and has a decidedly volitic texture like the roe of a fish. It is clean ore, a little heavier than the enclosing wall rock and is cheaply mined by the same methods, using the same tools and at about the same cost per ton as bituminous coal veins and requires no subsequent washing or mechanical concentration.

The principal high grade bed of the series, carries an average value of 70 per cent tri-calcium phosphate and an average width of 5 to 7 ft. In addition to this bed the shaly cross section of the phosphate formation at the Georgetown canyon group in Bear Lake county, owned by the Utah Fertilizer and Chemical Company, carries eight super-imposed beds of rock phosphate varying in average value from forty-three to seventy-five per cent tri-calcium phosphate and varying in thickness from three to twelve feet.

This remarkable cross section of the series, which is considered the maximum of value by the United States Geologists, contains 68 ft. of rock phosphate in thickness which shows an average value of nearly 60 per cent and represents a phenomenal resource of second grade rock of superior value to what is gladly used by the Russian farmer, who is well satisfied to get a fifty per cent rock phosphate in the fertilization of his soil.

The United States government has issued a series of bulletins on the Idaho part of this remarkable mineral field, and in their most recent bulletin, No. 577, by Richards and Mansfield, a final summary of the Idaho portion of the phosphate field they have covered in detail, gives an estimated resource of 2,666,290,000 tons. This estimate is based on a mineable depth of 2000 ft. below the outcrop of the beds, and these experts make no effort to estimate the enormous resource of lower grade material, ranging from 35 to 65 per cent.

Their assumption of a mineable depth of 2000 ft. is extremely conservative, as will be appreciated from the fact that just over the Wyoming line at Rock Springs, actual coal mining operations have been followed to a depth of 6000 ft. in the much softer and more flexible cretaceous shales and sand stones. The wall rocks of these phosphate beds in their more ancient sedimentary environments are much tougher and better adapted for underground mining operations than are the more recent coal formations and there isn't any question in my mind but that the phosphate deposits can be followed to an equal depth with the coal deposits of the Wyoming mines which would mean probably three times the resource estimated by the government geologists in the territory they have covered. Add to this, the fact that the Idaho part of the field hasn't been more than half covered by detail survey, and my personal knowledge of cross section exposures of the series fully as rich as the disclosures at Georgetown, a hundred miles north of that point, and I think it is a conservative estimate to say that the Idaho part of this great western phosphate field will contain fully ten billion tons of rock phosphate containing an average value of 70 per cent or better, and of the second grade rock about 50 per cent, probably one hundred billion tons in addition.

These deposits are known to extend for hundreds of miles north along the western border of Wyoming and to continue northwest into Montana as far as the main line of the Northern Pacific Railway at Garrison and also for some distance south of Idaho well into Utah and it is not unlikely that my estimates of the Idaho resources will be duplicated in the other states mentioned when the field has been fully surveyed.

The present method of using rock phosphate that is most popular is to saturate the fine ground raw rock with an equal weight of sulphuric acid which reduces the phosphatic contents to a soluble form and makes it immediately available as plant food when applied to the soil. There is at this time three hundred million dollars invested in the manufacture of mineral fertilizer in the southeastern states. These large investments have been largely supplied by foreign capitalists and this great industry is based on the ownership of phosphate deposits and makes a product that is designated at 2-8-2, which means that it contains 8 per cent phosphorus, 2 per cent potassium and 2 per cent nitrogen in soluble form, the bulk or substance of the product or carrier being common soil.

This dominant industry deprecates the use of phosphate in any other form but it has been absolutely demonstrated that the raw rock, ground extremely fine, to the consistency of Portland cement, and applied directly to the soil in conjunction with the intelligent system of crop rotation, including the growing of le-

guminous crops, plowing under an occasional crop of this class, with other waste crop residues, to supply humus and humic acid in the soil, that the finely ground raw rock phosphate will become available naturally and by this method the farmer can supply and make available, the requirements of his soil in phosphatic contents for one-third the cost of the concentrated form.

Mr. Cyril G. Hopkins, of the University of Illinois has gone into this subject in detail, and has demonstrated by repeated experiments over a series of years at the Illinois station, and cites a dozen other state experiment station experiences along the same line, that demonstrate that finely ground raw rock phosphate is all the farmer needs in addition to what is already available to his hands, to bring his depleted soil back to its primary fertility and productive capacity.

Mr. Hopkins illustrates an example in Illinois, where the use of raw rock phosphate has increased crop yields on depleted soil that would hardly reproduce the seed put on it, to the highest degree of maximum production and showing a profit of from four to eight hundred per cent over the cost of the phosphate used and the other contingent labor involved in increased crop production, and his story of the soil "The Farm that Won't Wear Out" and other books and pamphlets he has published and cited can be studied with interest and profit by any intelligent farmer as they go plainly into the basic laws of profitable crop production and maximum yields.

At the present time the greatest drawback to the introduction and use of the Idaho phosphate deposits is the transportation cost to available markets and the general idea that it is necessary to transform the rock into superphosphate by the costly acid process previously referred to. A campaign of education along this line will, however, I believe, open up a big market for this mineral in the Mississippi Valley states and the history of agriculture in this and other countries make the prospects of a big industry based on the development of these deposits, inevitable and with proper encouragement could be rapidly brought to a point of active production, as it has been found that the mineral can be mined and ground to a 100 mesh size and laid down at Missouri River points at a total cost of not to exceed \$10 per ton and probably for \$8, and at such a charge the farmer who is now getting a result of ten to twenty bushels of wheat per acre and twenty to twenty-five bushels of corn—from the same seed and little more labor can double his yield at less than half the cost of the increase and rapidly magnify the basic value of his land as a consequence, and a well scattered demonstration of these results in the Mississippi Valley states would doubtless stimulate a decided interest in the phosphate industry of Idaho, which I believe, is destined to become as important as that which now forms the basis of such large capital investments in Tennessee and Florida.

There is a general impression among agricultural authorities in the older states, that livestock farming is essential and must be adapted for the maintenance of fertility on all farms for the value of the manure fertilizer it produces, which is admittedly rich in both humus and the essential soluble salts of vegetation, but

how inadequate such a system of permanent soil fertility would be, is illustrated by Hopkins in the following statement. "Attention should be called to the fact that there are nine hundred million acres of farm land in the United States and only ninety million head of livestock equivalent to cows, including all farm animals. Will the manure from one cow serve to enrich ten acres of land? It should also be appreciated that one hundred bushels of grain will supply five times as many people as could live for the same length of time on meat and milk that could be made by feeding the grain to domestic animals. It is because of this fact that the consumer may sometimes boycott meat or other animal produce while he never boycotts bread, but let us hope that permanent systems of agriculture will become adopted in America for the production of both grain and livestock so that high standards of living may be maintained for all classes of people in this country."

In addition to the prospect of marketing our phosphate mineral in the finely ground raw state, it has been suggested by eminent chemists and in fact the subject was discussed in a recent paper by the last bulletin of the American Institute of Mining Engineers, that ammonia phosphate by electric heat may be made with waste furnace gases which might be utilized in this connection and a concentrated product of phosphorus produced at a cost of ten or twelve dollars per ton which would have a value of over a hundred dollars per ton and would stand transportation charges to any market.

In connection with the discussion of a complete fertilizer industry in Idaho, the recent discoveries of potassium and sodium salts in the southwestern corner of the state, are worthy of mention and are likely to afford a source of supply for the other elements of complete fertilizer that are used in the big fertilizer industries of the southeastern states.

These sodium and potassium deposits occur in a series of lake bed and ash bed formations in Owyhee county, Idaho, and border the base of the Owyhee range in Idaho and eastern Oregon. In this region there has been hundreds of claims located recently and the shallow development that has been put on them so far has disclosed some interesting conditions. In one instance a bed of amorphous silica resembling a sandy sediment that is thirty feet thick containing an average of 3 per cent water soluble potassium sulphate.

At other points rich sodium nitrate salts have also been found. These soluble salts are believed by Boise chemists, who have studied them, to have resulted from volcanic or solfateric action on the normal silicates of potassium and sodium for which the Owyhee range formations are noted and the prospects are very encouraging at this time for the southwestern Idaho field to provide available resources of these valuable salts.

The complete fertilizer industry of the southeastern states turn out a hundred and twenty million dollars' worth of product a year with a rapidly expanding annual yield and its duplication in Idaho is an industrial asset for this state worth figuring for and encouraging by every possible means.

The federal government has a million acres of the rich phosphate lands of southeastern Idaho withdrawn

from any form of entry and a tentative blanket withdrawal on any new discoveries, and our bureaucratic national overseers at Washington, in the face of constitutional law to the contrary, seem determined to make their tenure of title to this great natural asset of Idaho permanent, and only permit its development under an exacting red tape royalty leasing system—to the detriment of Idaho's industrial progress and in the interests of the vested interests of the southeastern states and of the market of phosphate bearing converter slags, carrying less than half the value in phosphorus of the billions of tons of our lower grade rock phosphate deposits.

The Idaho phosphate deposits are of such a nature that the ore of the richer beds can be completely removed by an intelligent system of practical mining and their operation does not need the petty red tape restrictions that a federal tribute leasing system must inevitably involve in competition with the free sovereign rights of the privately owned deposits in the south. If our resources of this mineral were limited by millions of tons, as those of the southern states are, we could with more grace and in patriotic national interest, submit to their conservation and restricted use, but, with a resource that can be figured in billions of tons, a practically exhaustless supply substantially protected against export by competitive railway rates, a most liberal policy and encouragement of its use by the government and in the specific interest of the state of its origin is warranted, and the national agricultural department could profitably set aside half of its great annual outlay in bringing the nation's average annual crop yield up 100 per cent, reducing the cost of living and increasing the basis of rural credits in land values several hundred per cent, a consummation eminently possible and whose basic crucial element of success is now lying dormant in Idaho's great phosphate resources.

Wireless communication with Tahiti has been possible since Dec. 28, 1915, when the radio station erected by the French Government was opened. Communication with the United States is via Samoa and Awanui, New Zealand, thence by cable to San Francisco. The rates have not yet been established nor has the station been assigned call letters. All messages during the duration of the war must be in French or, if in English, should be accompanied with the translation. A strict censorship is exercised and code messages are not accepted. It is expected that the cost per word to the United States via the route indicated above will be over \$1, and it is hoped that some arrangement may be made to transmit messages via Tutuila to Honolulu and thence to San Francisco. The all-wireless route just referred to would reduce the cost per word more than half and would insure a saving of time. The present installation of 10 kilowatt, with a wave length of 600 meters, can easily maintain communication with Tutuila. After the completion of the larger station of 300 kilowatt, and a wave length of 2500 meters, direct communication with Honolulu will be easily maintained, and even San Francisco, Sydney, and the French West Indies are expected to be reached.

THE EMPLOYEES' OBLIGATION.

The duty and obligation of an employee, to the employer, to the employment and to the dependent public; the attitude of the employer towards those duties and obligations; the effect that attitude may have upon the employment, on the service or on the public served, are vital public questions.

Whatever may be the facts with ordinary industries, the position of the employees of public service enterprises, particularly those of transportation and intercommunication, is as distinct and separate from that of the employees of an ordinary industrial, as the position of any public service enterprise is distinct and separate from that of an ordinary industrial enterprise.

Public service employees, nominally the employees or servers of the corporation, are the employees or servers of the public. It is the "service," not of any particular employee but of every employee, that the public pays for. Service is rendered by the employee directly to the individual. The quality of the service rendered depends upon the interest of the employee in the service and the attitude toward the public. Employees who come in direct contact with the public can, in whole or in part, nullify or make objectionably inferior the efforts or service of the best organized and most comprehensive system or of the most efficient methods. No system can give good service, unless there be a direct recognition on the part of the employee that he has a duty and obligation to the public served; and following that duty and obligation, there must be some accountability of some kind to someone, if that obligation is evaded and the service is not rendered in the way it could and should be.

Good service requires expertness, which can only come from experience acquired through continuity in position; it requires efficient system and method, enforced and carried out; it requires not the servile, but the respectful and implicit subordination of the employee to the system, the method, and necessarily to the officials of the organization; it depends upon co-operation and the co-ordination of the efforts of all, employer and employee.

Continuity of service requires at all times a sufficient number of trained employees to take care of the demands of the service, and it should be beyond the power of any part of the organization to lightly cast aside even an implied obligation.

There are two "parties" in all public service—the organization with its plant and facilities for giving service, and the employees who give the service. The employee is by tradition regarded as a part of the organization and subject to its discipline and control. To a certain degree in some cases this has been nullified by combination. If this combination or the possibility of it is to be admitted, then so far as is necessary to preserve the right of the public to a continuous and dependable service, it should be under the same control and regulation by the same bodies that the corporation itself is under.

If the fundamental laws would permit it and public sentiment could be created to enforce it, it would be very desirable to work out some practical plan to accomplish this result.

"Public services" are of such a nature as to create a dependency upon some one system. It is impossible to suspend or interrupt these services even temporarily without putting the public to great inconvenience and to much suffering. To cripple or destroy such services or the means or facilities for rendering such service would be a calamity, something that nothing could justify. The obligation on the system to give a continuity of service is so strong that no excuse except force majeure can be recognized. No argument or accumulation of causes could possibly justify those, who in any way controlled the situation, in doing anything either wilfully or through negligence which would result in suspension or interference with service.

Conversely, if employees are to be controlled they should also be protected. What, then, is the method of protection? In the past, boards of arbitration have been a resort when matters have come to an impasse. Special and independent arbitration bodies are temporary, do not possess and cannot appreciate all the factors, and what is most important, have no responsibility for the effects of their decision on other interests.

To adjust properly any question involving expenditure for any part, every factor in connection with the whole business should be considered—the revenue, costs or charges, and everything that affects these. This can only properly be done by one and the same body, which must have jurisdiction over all factors involved—and therefore the only logical body to regulate and protect public service employees is that which regulates the "public utility" itself and has the responsibility to the public for this regulation.

On the other hand, it is both unreasonable and impossible to expect the employee to admit or appreciate this unless at the same time the individuals of the public recognize and observe their obligation or duty towards these employees. Courtesy on the part of the public is too often overlooked or forgotten, and too often the public fail to recognize in their bearing and action towards these employees any direct relation or any of those obligations which all employers should have towards those who serve them, and towards those who are, at least for the moment, in a subordinate position. Too often the attitude of those demanding service towards the employees giving them service, is in unreasonable and undignified contrast to that which they should give and which they do give to the employees of their immediate personal establishments.—Annual Report American Telephone & Telegraph Co.

Electric heating of office buildings has been successfully accomplished by the Washington Water Power Company in the case of its four-story building in Spokane during the past three years. Cartridge heating units are employed in a special boiler supplying steam and ordinary steam radiators. A large substation building is to be similarly heated, using the existing plant with the substitution of electric heaters for coal fuel, the hot air being circulated through the boiler tubes by means of an electric fan. No determination of rates for commercial service has yet been made.

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The weakness of the electrical business seems to lie in its very foundation, among the thousands of dealers, salesmen and others who come in direct contact with the public. These public contactors are uninformed as to how to handle people. Nor is this otherwise than would naturally be expected, considering the newness of the electrical business. Much may be learned by studying older lines of trade which have passed through the chrysalis stage.

Consider the druggist, who stands in much the same relation to medical science, as does the dealer to electrical science. First he was technically informed, then he was licensed to dispense products which, while most beneficial, may also be most dangerous to life, and finally he has learned how to sell his wares to the public.

It is this last step that the electrical contractor is weak and consequently the entire structure of the electrical business is weakened. Electrical contractors who are dealers do not understand how to sell their wares to the public.

As a result, the central stations, sometimes unwillingly, have been put to the necessity of selling current consuming devices in order that proper and sufficient appliances be put on their lines. Frequently have they signified their willingness to give up this selling task, and frequently have they been forced to resume the practice because of the inability of the electrical dealer to sell appliances. The greatest fault in the electrical business today is that the majority of dealers do not know how to sell.

Then again it is customary to decry the competition of department stores, without sensing the fact that the day of the department store is rapidly passing and that the specialty shop is again coming into its own. The electrical business is pre-eminently one calling for specialized knowledge and the same motive that induces a woman to patronize an exclusive waist shop or a man to buy his hats or shoes at a specialty shop should be appealed to by electrical merchants.

Good customers are lost by poor salesmen every day. A man may enter a store to buy lamps because he needs them. He is confronted by a mere order-taker—the undertaker of unsuccessful business. No effort is made to sell him an electric iron, toaster, or perculator, though his house is wired, otherwise he would not be buying lamps. The spirit of service is lacking in most electric shops. Such inattention, discourtesy and crass ignorance drives away trade.

Would that most electrical dealers could see themselves as their customers see them—through their front windows. Dead flies, cobwebs and dirt have destroyed their usefulness, even as holes to let in light. This window space is a dealers' best display stand. The more thought and care expended in proper window dressing the more people who will be brought into the store to buy. This is only one phase of advertising, concerning which the electrical dealer seems to know little or nothing. Newspaper display and direct circularization as selling aids are as a sealed book to him.

The task of teaching the dealer approved merchandising methods has lately been assumed by the jobber and the jobber's salesman. The jobber has been impressed with the fact that in order for him to sell more goods the dealer should understand how to dispose of what he has already bought. He realizes that it is to his benefit, primarily, not to sell supplies but to teach dealers how to sell them profitably.

Closely identified with the difficulty in teaching the dealer how to sell goods is the problem of teaching him a realization of the meaning of costs. Since prices are being continually reduced by competition profit can come only from cutting costs faster than competition lowers prices. Nor is knowledge of how to reduce costs a secret to be jealously guarded for fear that one's competitor may learn. This is a case when the more widely knowledge is disseminated the more generally will business benefit. Ignorance of costs is responsible for most of the ruinously low bids that are made. Not only does the low bidder lose money, but also he who bids at a price that affords a fair profit.

With a more general appreciation of these facts will come a greater stability to the electrical business. Far sighted men of affairs are now bending every effort to improve conditions, not so much from an altruistic spirit, but in the belief that it is only by helping others that they can help themselves.

The very suddenness of the prosperity which has recently come to many lines of American business has brought certain embarrassments which, like the transient phenomena accompanying any rapid adjustment of stored energy, require attention in order that they may not destroy, or at least seriously cripple, the industry so benefitted. The master hand of fate has closed the switch throwing heavy surges of high voltage business into unprotected lines. Violent oscillations have been set up as a result of this change in circuit conditions, wherein potential energy has been instantaneously made kinetic. Destruction can be obviated only by a rapid absorption of the transferred energy by some safe medium.

This analogy between electrical and industrial transients, is more than a chance comparison. The phenomena are like the sudden acceleration of a moving column of water in a penstock or the rapid change of motion in any moving body. Some cushioning means, some method of energy absorption, should be provided if damage is to be avoided.

There is yet time to take thought, to give philosophic consideration to the future of our financial war brides and their war babies as well as to the more legitimate offspring. As the country was unprepared for profits, the new energy is in danger of dissipation. The net earnings of many a concern for 1916 will be as large as the gross earnings for 1915. One motor manufacturer has sold more motors during the first quarter of this year than during all of last year.

To translate these extraordinary profit into terms of transient value would bring a period of wild speculation. Would it not be better to safeguard the future by dealing intelligently with the present? Capitalization of present profits by issuing new shares to absorb them is unsafe because this kind of business is not permanent. It is purely ephemeral. Far better would it be to mobilize reserves against unknown future conditions. Fate will as inevitably open the switch as suddenly as she closed it. Equally violent oscillations in value will occur, as has occurred, in these transient "imaginaries."

But those corporations that use these profits in a permanent way, in retiring bonds, in making needed plant additions and in writing off intangible assets, will add to the real wealth of the country. While such dividends as are declared will undoubtedly be used in speculation this will promote new developments in railroads and other public utilities and will thus advance the general welfare. Just as the transient term is essential to the operation of alternating current rectifying apparatus, so it can be made of permanent value if rightly applied. But first is it advisable to convert our temporary prosperous condition into tangible present value, lest like the evanescent hues of the sunset, it vanishes even while we gaze.

The ordinary factor of safety is an anachronism which should be no longer sanctioned among intelligent engineers. It is a relic of the time when one man's guess was as good as the next. This was before many of the fundamental laws of engineering design had been formulated, when empirical rules were in vogue and rule of thumb common practice.

Now conditions are different. Precise, rational formulas have been developed, standards have been established and records have been kept, so that it is possible to accurately predict the behavior of materials under compression, tension or shear. Instead of building a structure to withstand assumed stresses whose real values were not known, and then arbitrarily increasing the dimensions five or six times to care for unforeseen contingencies, the design is now based upon known strength of materials and with a knowledge of the exact stresses which will be met in extreme cases. Judgment predicated upon statistics of past experience will determine limiting conditions to be provided for.

The factor of safety was originally adopted as an allowance for error and was thus in reality, a "factor of ignorance." It has been repeatedly demonstrated by actual test that supposedly safe factors were not sufficiently high and that the only safe method is to base design upon analysis. On the other hand clumsy designs have been replaced by logical ones, so that no excess of material adds unnecessarily to the cost. With the elimination of the several elements of uncertainty it is possible to allow simply a factor of assurance. This may be greater or less than the old factor of safety, depending upon conditions.

Safe Absorption of Industrial Transients

Factors of Assurance

PERSONALS

S. K. Colby, assistant general sales manager Aluminum Company of America, is at San Francisco.

H. S. Whiting, vice-president Pierson, Roeding & Co., has returned to San Francisco from Seattle.

B. A. Wagner, general manager Electrical Agencies Company, has returned to San Francisco from Los Angeles.

Allen G. Jones, sales engineer with the San Francisco office of the General Electric Company, is at Schenectady.

C. W. Tank, general director of sales for the Fairbanks-Morse Company of Chicago, is a recent visitor at San Francisco.

A. H. Noyes, salesman Electric Appliance Company, has returned to San Francisco from Oregon and Northern California.

H. Jankelson, treasurer-manager Incandescent Supply Company, San Francisco, expects to leave for the East shortly.

L. L. Pratt sales engineer for C. H. Wheeler Manufacturing Company, has returned to Philadelphia, after a brief visit to the Pacific Coast.

A. G. Wishon, general manager of the San Joaquin Light & Power Company of Fresno, spent a few days the latter part of the week at San Francisco.

A. S. Lindstrom, Pacific Coast representative Thordarson Transformer Company, has returned to San Francisco from a three weeks trip throughout Southern California.

B. H. Scranton, president of the American Electrical Heater Company, and **Eph. Doherty**, special representative, have returned to Detroit after an extended visit to California.

Mark Ryan, city electrician and electrical dealer at Redwood City, who was the victim of a recent automobile accident, has recovered sufficiently to be able to spend a few days at San Francisco.

C. G. A. Baker, vice-president and treasurer of Baker-Joslyn Company, has returned from a trip into the north-western territory, having spent about a week at the Seattle branch of his company.

Ed. Y. Porter, formerly employed as a valuation engineer by the California Railroad Commission, has recently been appointed distribution engineer for the Southern Sierras Power Company at Riverside, Cal.

M. L. Joslyn, president of Joslyn Manufacturing & Supply Company, Chicago, and president of Baker-Joslyn Company, San Francisco, is expected to arrive in San Francisco this week from a trip to Honolulu.

Orton E. Goodwin, a former publicity man of Portland, has been appointed California manager for the American Valveless Pump Company of Portland and will establish headquarters at Los Angeles.

L. A. McArthur, assistant general manager of the Pacific Power & Light Company of Portland, recently addressed the engineering students of the Oregon Agricultural College on the subject of "Utility Economics."

R. H. Davis, salesman of appliances, Washington Water Power Company, Spokane, Wash.; **C. F. Dobson**, operator Great Falls Power Company, Great Falls, Mont.; **John Jay Donnohue**, power department, Utah Power & Light Company, Salt Lake City, Utah; **Ronald C. Griffin**, office assistant to superintendent of electrical distribution, Pacific Gas & Electric Company, Oakland, Cal.; **Arnold Keller**, power house foreman, Cornucopia Mines Company, Cornucopia, Ore.; **L. C. Lull, Jr.**, clerk, Pacific Light & Power Corporation, Los Angeles, Cal.; and **Rupert Wall**, foreman Brighton Substation, Great Western Power Company, Sacramento, Cal., have been elected associate members of the American Institute of Electrical Engineers.

OBITUARY.

Robert M. Jones, well known engineer of Denver, Colorado, died March 1st at Carlsbad, N. W. Mr. Jones was born in Wayne, Ohio in 1853 and began his engineering career as a U. S. Deputy Surveyor in locating township and territorial boundaries, principally in New Mexico, Indian Territory and Wyoming. For this work, in 1880, he applied the Burt solar attachment to the engineers' transit and patented the Jones Latitude Arc for observing latitude at any time of day, and this was required, for a number of years on instruments used on important Government surveys.

In 1883 he associated with the Edison Electric Illuminating Company and built a steam plant at Laramie, Wyo., the second Edison three-wire system central station in the United States, and third in earning capacity of all plants built at that time. Following this he built over a dozen such plants in surrounding states. He also built and operated the first electrically driven flour mill.

Mr. Jones was a pioneer in electric street railway work. In 1889 he went to Salt Lake City and built under contract the three original systems and a steam power plant there, and two electric railway systems in Montana. On account of the then undeveloped state of the industry, he devised and patented numerous appliances for this work, many of which are still in use. He then established an electrical contracting and supply business, representing the Sprague and Edison General Electric Companies. During the 1893 panic he financed and began constructing the Big Cottonwood "Stairs" hydroelectric plant to supply water to Salt Lake City. This plant was followed by the "Jordan Narrows" plant south of Salt Lake City and the plant of the Pikes Peak Power Company, supplying power to Victor and Cripple Creek, Colorado. He located and partially constructed the first plant of the Nevada-California Power Company on Bishop Creek, California, for supplying power to the Goldfield and Tonopah mining districts in Nevada. This was followed by the plant of the Black Hills Traction Company at Spearfish, S. D., the first installation in this country using the double-discharge type Francis turbines. For several years he has given much of his time to the development of a process for making hollow reinforced concrete poles, piles and pipe without the use of forms. At the time of his death Mr. Jones was engaged in making repairs on the Tansill dam on the Pecos River at Carlsbad. He leaves a widow and five sons, Barton M., Robert L., Kirby V., Paul W., and Allan B. Jones.

TRADE NOTES.

The General Electric Company has been given a contract to furnish 24 ornamental street-lighting arc lamps at Red Bluff, Calif., and 35 units for installation at Gilroy, Calif.

The officers of the Washington Association of Electrical Contractors and Dealers, recently organized at Seattle, are: **W. M. McKenny**, president; **H. A. Wilson**, vice-president, and **H. D. Allison**, secretary-treasurer.

Butte Engineering Company of San Francisco has closed a contract for the City and County Hospital, wiring, signal system and special apparatus, amounting to \$25,750. This company is at this time developing electrical temperature regulator for pasteurizing milk.

Morrison Electric Company of Portland are making a very complete electrical installation in the J. H. Henry residence on Westover Terrace, including many novel and up-to-date electrical conveniences. They also have secured the contract for the electrical work in the new Friedman building at Ninth and Davis streets; lighting fixtures for the Masonic Temple at Heppner, Oregon; electrical work in the new Garage building at Thirty-seventh and Belmont streets and are doing the electrical lighting for Rosenblatt's new store.

MEETING NOTICES.

San Francisco Section A. I. E. E.

Prof. Harris J. Ryan will discuss "Transmission Line and Insulator Losses at Extremely High Voltages" at the March 31st meeting, 8 p. m., Engineers' Club. The paper will be illustrated with lantern slides.

Los Angeles Section A. I. E. E.

At the March 21st meeting Dr. Arthur E. King, physicist of the Mt. Wilson Solar Observatory, spoke on the relation of electrical engineering to the problems of the observatory, illustrating his address with some interesting lantern slides.

Portland Section A. I. E. E. and N. E. L. A.

The regular weekly luncheon was held March 15th at Christopher's, with one hundred and five members present. L. S. Granger, with Fairbanks-Morse Company, chairman of the day, introduced Michael F. Shannon, exalted ruler B. P. O. E. No. 99 and former deputy district attorney. He talked on the life of St. Patrick, the patron saint of Ireland, and told from history and legend, some very interesting stories about Ireland and the Irish people. A couple of real darky minstrels played ragtime and sang character songs.

San Francisco Electrical Development and Jovian League.

The March 15th luncheon, with Vice-President C. C. Hillis at the helm, transacted some little business, in addition to the entertainment features. The executive committee was instructed to endeavor to have two more inspectors put on in the Department of Electricity, as contractors were at present being held up by delay in getting permits. H. V. Carter and J. W. Redpatch were named as a committee to draw up suitable memorial regarding Frank J. Symmes. C. E. Wiggin, as chairman of the day, then introduced J. B. McCargar, assistant cashier of the Crocker National Bank, who gave an extended address denouncing plans for governmental aid in extending rural credits.

San Francisco Jovian Smoker.

A smoker and joviation have been arranged for by Tribune Murray Orrick and E. A. Wilcox to be held at San Francisco on the evening of April 6th.

Some astounding entertainment features have been planned and a good time is assured all who attend. All electrical men are invited, irrespective of whether they are members of the Jovian Order. The following committees have the affair in charge. Arrangements, A. H. Halloran, W. W. Briggs, James Barry; Entertainment, R. E. Fisher, A. E. Drendell, F. H. Poss; Refreshments, Wm. Neelands; Financial A. E. Rowe, E. A. Wilcox; Gate Prize, Albert Meinema, Hal Lauritzen, Secretary H. E. Bittman.

Portland Section A. I. E. E. and N. E. L. A.

The bi-weekly luncheon was held Thursday, March 16th, at the Portland Commercial Club. A. C. McMicken acted as chairman, and announced that from this date on the programmes would be rotated between various organizations represented in the Luncheon Club. The next luncheon will be under the auspices of the Southern Pacific Company. The speaker of the day was Captain Heggeman of the U.S.A., who spoke on "The military policy of the United States." Captain Heggeman pointed out that we never have had any military policy and that our wars cost a great deal more than if we had been adequately prepared at all times. Many times the wars would have been avoided or shortened materially by having had a trained army; volunteer armies cost more for pensions than the wars cost originally in the United States. The United States is rich in military resources but weak in having a system to assembly same for use as a defensive weapon. He also told how nearly every president of the United States from Washington to Wilson had called the nation's attention to the criminal neglect of Congress in not establishing a definite and sane military policy for defense of the country. The regular monthly meeting of the joint sections of the A. I. E. E. and N. E. L. A. will be held in the Electric Building at 8:15 p. m., April 11, 1916.

PORTLAND A. I. E. E. AND N. E. L. A. SECTION

The regular monthly meeting was held in the Electric Building, Tuesday evening, March 7. The chairman of the evening was Mr. Paul Lebenbaum. Gibson, of Forster-Gibson Co., had a series of films and slides depicting the utilization of electric vehicles, which he explained. E. M. Cutting, Pacific Coast manager of the Edison Storage Battery Co., made a few remarks, stating that he thought that the electrical vehicle associations should combine with the N. E. L. A. The paper of the evening was delivered by Dr. Morgan of Reed College on "Why America Cannot Compete With Germany in Certain Lines of Chemical Industries." Dr. Morgan said in part:

(1) The common people had no interest in the chemical industry until it was brought home to them by the laundries notifying them that they would not guarantee colors sent them. Then arose a clamor through the public press asking the reason for such a state of affairs.

(2) The chemical manufacturing industry in the United States amounts to about \$500,000,000 annually.

(3) The German dye industry amounts to \$80,000,000 annually, with a profit of 22 per cent.

(4) Many private businesses in the United States exceed this amount, such as the 5-10-15-cent stores, Ford Automobile Company, Sears-Roebuck Co., etc.

(5) Many chemical industries have been developed here in the United States, so there is plenty of ability if conditions are O. K.

(6) The larger industries which use chemicals and have been developed successfully are aluminum, calcium carbide, carborundum, graphite, emery, steel, oil, beef packing, cottonseed oil, etc.

(7) Now, why are there on dyes produced? The answer is that the large textile industries caused the tariff to be so placed that it caused them to go out of business as they could not compete against German competition. The German dye manufacturers were organized and sold through one selling organization.

(8) Dyes were made in Albany, N. Y., in 1866, and eight other places grew up shortly afterwards, when a tariff of \$1 per pound and an ad valorem of 35 per cent was in effect. In 1883 the duty of \$1 per pound was taken off, the 35 per cent ad valorem being retained on a few, but mostly free. Then five establishments went out of business, leaving only four. The tariff was again amended downward in 1897, and again in 1910 when even 10 per cent duty was placed on the raw material imported for the industry.

(9) It was also stated that the German dyes were better but this is not so and has been proven so.

(10) There are approximately 900 dyes produced in the industry.

(11) Germany encouraged the industry until there are about 1100 different producers who pool their products. The reason for this encouragement is the fact that many of the by-products of the industry are used in the manufacture of ammunition.

(12) The actual cost of the dye in a blue serge suit of clothes to the manufacturer for a man is 5 cents, with a protective tariff of 7 cents.

(13) Since the war demands for dyes have arisen; 30 different dye establishments have been established in the United States.

(14) Germany also controls all the potassium salts produced.

(15) The manner of handling the tariff in regard to the dye industry illustrates the fact that experts and commissions should handle same and not the politicians.

(16) Germany illustrates this method of procedure in all her activities while the United States shows how un-united we are and how we suffer in comparison.

APPLICATIONS TO CALIFORNIA WATER COMMISSION.

The commission has received an application from W. L. Shaffer of Seneca, Plumas county, asking permission to appropriate 400 second feet of water from the North Fork of the Feather River for mining and milling purposes. The works contemplate a concrete and masonry dam, with ditch, pipe line and flume two miles in length. There is a total fall of 0 ft. vertically, which is figured to produce 3000 theoretical horsepower, to be developed at an electric plant. The works are to be located at Scott's Bar, 1½ miles below the point of intake and at Seneca Gold Mine Company's mine and Van Winkle mines, half a mile further down. The estimated cost of the improvements is \$45,000.

E. R. Walker of 607 J street, Sacramento, has applied to the commission for permission to appropriate 200 second feet of water from the South Fork of the American River for agricultural purposes. The engineering data on the diversion works are not complete, neither has the estimated cost been determined, but the project is one of considerable magnitude, comprising a storage reservoir with capacity of 50,000 acre feet or 16,335,000,000 gallons, also a main canal some 35 miles in length. The lands to be irrigated are in Sacramento and Placer counties.

Some time ago, the Sespe Light & Power Company of Los Angeles, applied to the commission for permission to appropriate water for a project which contemplated among other things, the irrigation of some 30,000 acres of land in Ventura county. The company has now made a separate application for permission to appropriate 125 second feet for power purposes, namely the generation of electricity for commercial use. The application sets forth a proposed main canal and pipe line nine miles in length; a diversion dam 175 ft. high, 220 ft. on top and 75 ft. on bottom. The dam construction is of loose rock, concrete, masonry and rip-rap, with waste-way around dam. There is a storage reservoir of 57,750 acre feet or nearly 19,000,000,000 gallons. By a fall of approximately 1000 ft. it is proposed to generate about 3000 theoretical horsepower. The estimated cost of the Sespe project is \$2,000,000.

Claudie A. Strabley of Dixieland, Imperial county has applied to the commission for permission to appropriate 150 miners' inches of the waters of Cariso Creek, a tributary of the San Felipe River. He intends to divert the water by means of a 26 h.p. pumping plant carrying the water by means of a ditch half a mile long to 160 acres of land at an estimated cost of \$1200. H. L. Welch and Kate E. Oldham of El Centro are witnesses for applicant. Mr. Strabley also makes application for another diversion of 50 miners' inches from a nearby point. By means of a diversion dam and ditches at a cost of \$800, he intends to carry additional water to the same lands.

A. S. Hinkley and W. H. Hawken of Modesto have been granted a permit by the commission to appropriate two second feet of the waters of Wilson Creek in Mono county, tributary to Mono Lake. By a fall of 440 ft., it is proposed to generate electricity to the extent of 100 theoretical horsepower. The plant proposes a tangential water wheel direct connected to an electric generator, which will supply heat, light and power to operate milling machinery. The commission has imposed a condition that the water, after its use for power, shall be returned to the creek by such conduit as will eliminate transmission loss. The estimated cost is \$2500.

NEWS OF OREGON PUBLIC SERVICE COMMISSION.

The commission has set dates for hearings as follows: April 3, 10 a. m., Grants Pass, California-Oregon Power Company; April 4, 1 p. m., Medford, California-Oregon Power Company; April 5, 9 a. m., Medford, Home Telephone Company of Southern Oregon; April 7, Klamath Falls, 9 a. m., California-Oregon Power Company.

BOOKS REVIEWED.

"Hydraulic Tables," by Jos. H. Harper; 192 pp.; 4x6½ in.; leather bound. Published by D. Van Nostrand Company, New York City, and for sale by Technical Book Shop, San Francisco. Price \$2.00.

This pocket book is avowedly a practical compilation and calculation of tables accurate enough to solve field problems in the flow of water in circular pipes under pressure, timber flumes, open channels and egg-shaped conduits. The tables are based upon the D'Arcy, Bazin and Kutter formulas, and are supplemented by comparative charts. The accuracy of these several formulas are discussed. A number of conversion tables are also given, together with a brief account of weir measurement. The book fills its purpose admirably, though not fitted for refined measurements or more technical uses.

"Irrigation Practice and Engineering," by B. A. Etcheverry; Vol. I, Use of Irrigation Water and Irrigation Practice; 213 pp.; 6x9 in. Price \$2.00; Vol. II, Conveyance of Water; 364 pp.; 6x9 in. Price \$3.50; Vol. III, Irrigation Structures; 438 pp.; 6x9 in. Price \$4.00. Published by McGraw-Hill Book Co., New York, and for sale by Technical Book Shop, San Francisco.

The plan of publishing this complete treatise on all phases of the subject in three volumes is one to be commended, as thereby the reader can find the information of use to himself in a book of convenient size, instead of in an unwieldy volume of over one thousand pages. The author is head of the Department of Irrigation at the University of California, and unusually well qualified to write upon the subject. The three volumes admirably fill the needs of teachers and students in technical colleges and form a valuable reference work for engineers, managers and superintendents of irrigation systems.

The first volume is, in a measure, introductory, and treats of the best methods of utilizing available water. The conservation of soil moisture and its effect on plant growth is recounted in detail, with special reference to water requirement of various crops, approved time to irrigate, duty of water, preparation of land and distribution of water. The concluding chapter deals with the selection and cost of a small pumping plant. It contains matters of value to the irrigator.

The second and third volumes are written for the engineer. The one is concerned with preliminary investigations, locations, computations, conduit design and construction to minimize silt and seepage (including canals, flumes, tunnels, metal and concrete pipes) and special consideration of inverted siphons and auxiliary works. The other deals with diversion works, head-gates, the various details of main and lateral canals, crossings, special types of distribution systems and measuring devices. Numerous illustrations of current practice are given with comments thereon, so that the treatise, as a whole, is the most comprehensive yet published on this subject, which is of special interest to Western engineers and power companies.

"The Diesel Engine in Practice," by J. E. Megson and H. S. Jones; 136 pp.; 4½x6½ in.; leather bound. Published and for sale by Technical Publishing Co., San Francisco. Price \$2.00.

This is essentially a book for the use and instruction of plant engineers. The authors have drawn from a wide practical experience and brought into compact form much that is necessary to guide in the selection, installation and operation of Diesel engines for stationary and marine purposes. After a brief historical introduction and account of experience with early installations, due consideration is given to the fuel oil question and the effect of altitude. A large section is devoted to the care and operation of engines in general, with special reference to various types. The life and reliability is thoroughly discussed. Complete illustrated descriptions are given of all makes of modern engines in commercial use and under the general title of commercial conditions complete comparative analyses of costs are given.



NEWS NOTES



ILLUMINATION.

TEMPE, ARIZ.—The city is considering the installation of a municipal lighting plant.

PARLIER, CAL.—At a recent election held here the proposition to form a lighting district carried.

FRESNO, CAL.—April 18th has been set as the date for holding the Del Rey lighting district election.

MERCED, CAL.—A petition from Atwater asking for a lighting district, was filed by the county supervisors.

CHICO, CAL.—Light and power will be furnished the Paradise section by the Pacific Gas & Electric Company's extension out of De Sabla.

EVERETT, WASH.—J. L. Fountain, 506 Twelfth Ave. N. E., Seattle, is interested in the construction of a hydro-electric plant in the Sauk River.

BAKERSFIELD, CAL.—An electrolier lighting system for Bakersfield similar to the new one in Fresno was suggested in a report recently submitted to the Chamber of Commerce recently.

FRESNO, CAL.—The trustees have awarded the contract for the construction of an electrolier street lighting system upon each side of J street from Merced to Tuolumne and on Tuolumne street from J to I streets, to the Central State Electrical Company for \$1278.

CLOVIS, N. M.—A resolution has been passed by the city council providing that an election be held on April 4th to vote on bonds in the sum of \$35,000 for the purpose of securing the funds for the extension and improvement of the water, sewer and electric light systems.

ALAMOGORDO, N. M.—The town of Alamogordo has made a contract to purchase the properties of the Alamogordo Improvement Company, Water Works and Light & Power Company for \$300,000. This contract will be submitted at an election on April 4th, when the matter of a bond issue for that amount will be decided.

LOS ANGELES, CAL.—That the city has signed light and power contracts with 60 per cent of the consumers in the district north of East Main street and east of the river is made known by E. F. Scattergood, chief engineer of the power bureau. The district includes East Los Angeles, Garvanza and Highland Park. It is served by the Pacific Light & Power Company and was selected by the Public Service Commission for a beginning in a local distributing system, so that if the Edison system should be taken over there would be no duplication of city lines. The contracts do not stipulate a definite time for the beginning of delivery of light and power, but the price is fixed at 10 per cent below the present rates.

TRANSMISSION.

FILLMORE, CAL.—Arrangements have been completed whereby the Ventura County Power Company will install a system to distribute electricity in the Bardsdale community.

BAKERSFIELD, CAL.—The board of supervisors has granted a franchise to the Pacific Light & Power corporation to construct an electrical distribution system over certain public highways in Kern county.

COULEE CITY, WASH.—An ordinance has been passed by the council providing for the construction and operation by the Grant County Power Company of a pole and conduit system for the transmission of electric power and light.

CHELAN, WASH.—Those in close touch with the Great Northern Railway Company here state that the railroad company is preparing to make a start this summer on the construction of their proposed huge hydroelectric power plant

at Lake Chelan, which will involve an expenditure of over \$3,000,000.

YREKA, CAL.—Plans are being made by the California-Oregon Power Company to extend its field of operations into Trinity county this spring. A ten-year contract has been made with the Yukon Gold Company to supply power for its dredging operations near Carrville, and arrangements are under way with another company to furnish a part of the power needed in its mining work. The new power line will be built into Trinity county by way of Lamoine, and construction work will be started soon. The line will be completed next fall or early winter, by the time the first dredger is ready for work.

TELEPHONE AND TELEGRAPH.

OROVILLE, CAL.—Permission has been granted Richvale residents to erect a telephone system.

RITZVILLE, WASH.—A farmers' telephone company is being organized which will operate a system of rural phones extending from a point four miles east of Cunningham to the county line.

WENATCHEE, WASH.—The forestry department will extend its telephone system in the Entiat and Chelan forests this summer. The line in the Stehekin District will be improved and new lines built on the Chellin and Entiat watershed.

SAN FRANCISCO, CAL.—At the annual meeting of the stockholders of the Pacific Telephone & Telegraph Company directors were re-elected as follows: Louis Glass, F. W. Eaton, Chas. J. Deering, A. B. Cooper, S. Waldo Coleman. The directors re-elected the following officers: Louis Glass, president; F. W. Eaton, and S. Waldo Coleman, vice-presidents; Chas. J. Deering, treasurer, and H. W. Smith, Secretary.

WATERWORKS.

HARLOWTOWN, MONT.—The city has voted \$15,000 to extend and improve the water system.

LOVELOCK, NEV.—A bond issue of \$80,000 was recently voted for the installation of a new water system for the town of Lovelock.

HONOLULU, T. H.—The total cost to taxpayers of Honolulu for installing a complete system of water meters throughout the municipality is estimated at \$83,765.

SANTA MARIA, CAL.—The bid of the Anglo-London Paris Bank of San Francisco for \$75,000 worth of water bonds recently voted has been accepted by the city trustees.

TACOMA, WASH.—On the recommendation of Commissioner Drake the council has voted to extend the Mullen franchise under which the Tacoma Water Supply Company is serving North End residents.

SANDPOINT, IDAHO.—The committee appointed by Mayor Himes to investigate the practicability of Sandpoint building or purchasing a municipal water plant reported in favor of the employment of an expert engineer in gathering data before taking definite action.

CANBY, ORE.—In a report submitted by Engineer Cobb of Oregon City who has surveyed and appraised the waterworks system owned by Mr. Lee, he placed a valuation of approximately \$5000 upon the plant, and estimated that a new system could be built for \$18,000.

SEATTLE, WASH.—Plans have been completed by the city engineer's office for the construction of an auxiliary water and fire protection system for the Rainier Beach District to cost \$30,000. Plans call for the construction of a steel water tower 119 ft. high, and a steel tank 46 ft. in diameter. Bids for the work will be called at once.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

- | | | | |
|---|----|--|-----|
| A-1 American Ever-Ready Works of National Carbon Co. | 4 | M-4 Morse Chain Co. | 3 |
| Los Angeles; 755 Folsom St., San Francisco; Seattle. | | Monadnock Bldg., San Francisco. | |
| A-2 Atchison, Topeka & Santa Fe Railway Co. | | M-3 Moore & Co., Charles C. | 3 |
| 673 Market St., San Francisco; 1218 Broadway, Oakland. | | Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland; | |
| P 1 Baker-Joslyn Company | 3 | Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; | |
| 71 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 E. Second St., Los Angeles. | | Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson. | |
| J-2 Benjamin Electric Manufacturing Co. | | N-1 Nason & Co., R. N. | |
| 590 Howard St., San Francisco. | | 151 Potrero Ave., San Francisco. | |
| B-5 Bridgeport Brass Co. | 3 | N-6 National Carbon Company | 4 |
| (See Pierson, Roeding & Co.) | | Cleveland, Ohio. | |
| C-1 Century Electric Co. | 12 | N-2 National Conduit & Cable Co., The | |
| 906 So. Hope St., Los Angeles; 56 Natoma St., San Francisco; 65 Front St., Portland, Ore. | | Trust and Savings Bldg., Los Angeles; Rialto Bldg., San Francisco. | |
| C-3 Crocker-Wheeler Co. | | N-3 National Lamp Works of G. E. Co. | |
| Crossley Bldg., 618 Mission St., San Francisco; 228 Central Avenue, Los Angeles. | | (All Jobbers.) | |
| C-4 Cutler-Hammer Manufacturing Co. | 5 | N-4 New York Insulated Wire Co. | |
| 579 Howard St., San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles. | | 629 Howard St., San Francisco. | |
| D-4 Davis Slate & Manufacturing Co. | 4 | N-5 Northwestern Pacific Railroad | |
| Chicago, Ill. | | 808 Phelan Bldg., San Francisco. | |
| D-2 Dearborn Drug and Chemical Works | 11 | O-1 Okonite Co. (The) | 12 |
| 355 East Second St., Los Angeles; 301 Front St., San Francisco. | | (All Jobbers.) | |
| E-1 Edison Lamp Works of General Electric Co. | | P-1 Pacific Electric Manufacturing Co. | |
| Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles. | | 80 Tehama St., San Francisco. | |
| E-2 Edison Storage Battery Supply Co. | 11 | P-2 Pacific States Electric Co. | 2 |
| 441 Golden Gate Ave., San Francisco. | | 236-240 So. Los Angeles St., Los Angeles; 90 Seventh St., Portland; 200-210 Twelfth St., Oakland; 575 Mission St., San Francisco; 307 First Ave. So., Seattle. | |
| E-3 Electric Agencies Co. | | P-4 Pelton Water Wheel Co. | 11 |
| 247 Minna Street, San Francisco; Central Building, Los Angeles. | | 2219 Harrison St., San Francisco. | |
| Electric Novelty Works | 5 | P-5 Pierson, Roeding & Co. | 3-4 |
| 533 Mission Street, San Francisco, Cal. | | Pacific Electric Bldg., Los Angeles; Rialto Bldg., San Francisco; Colman Bldg., Seattle. | |
| E-4 Electric Storage Battery Co. | | P-7 Pittsburgh Piping & Equipment Co. | 12 |
| Pacific Electric Bldg., Los Angeles; Spalding Bldg., Portland; 118 New Montgomery St., San Francisco; Colman Bldg., Seattle. | | Monadnock Bldg., San Francisco. | |
| E-5 Electric, Railway & Manufacturing Supply Co. | 11 | S-1 Schaw-Batcher Company, Pipe Works, The | |
| 34 Second St., San Francisco. | | 211 J St., Sacramento; 356 Market St., San Francisco. | |
| F-1 Fairbanks, Morse & Co. | 5 | S-3 Simplex Electric Heating Co. | 12 |
| Los Angeles; Portland; 651 Mission St., San Francisco; Seattle; Spokane. | | 612 Howard St., San Francisco. | |
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| G-1 General Vehicle Co. | | S-6 Standard Underground Cable Co. | |
| 1117 Van Ness Ave., San Francisco; 331 Wall St., Los Angeles; British Columbia Electric Ry., Ltd., Vancouver, B. C. | | First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Yeon Bldg., Portland; Central Bldg., Seattle, Wash. | |
| H-1 Habirshaw Wire Co. | | T-1 Thomas & Co., R. | |
| (See Western Electric Company.) | | (See Western Electric Co.) | |
| H-2 Hemingray Glass Co. | 11 | T-2 Tubular Woven Fabric Company | |
| 330 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco. | | Pawtucket, R. I. | |
| H-5 Hunt, Mirk & Co. | | W-2 Western Electric Co. | |
| 141 Second St., San Francisco. | | Eighth and Santee Sts., Los Angeles; 1901 Telegraph Ave., Oakland, Cal.; 630 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore. | |
| H-7 Hurley Machine Co. | 2 | W-4 Westinghouse Electric and Manufacturing Co. | 6 |
| New York and Chicago. | | 50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; 165 Second St., San Francisco; Second and Cherry Sts., Seattle; Paulsen Bldg., Spokane. | |
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| Fobes Supply Co., Portland and Seattle. | | 141 Second St., San Francisco. | |
| I-2 Illinois Electric Co. | | W-6 Westinghouse Lamp Co. | |
| 261-263 So. Los Angeles St., Los Angeles. | | (See Westinghouse Electric & Manufacturing Co.) | |
| L-1 Leahy Manufacturing Co. | 5 | W-8 Western Pipe & Steel Co. | |
| Eighth and Alameda St., Los Angeles. | | 444 Market St., San Francisco; 1758 North Broadway, Los Angeles. | |
| L-2 Locke Insulator Manufacturing Co. | 4 | | |
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| M-2 McGlaughlin Manufacturing Co. | 5 | | |
| Sunnyvale, Cal. | | | |

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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ILLUMINATION OF OAKLAND'S AUDITORIUM.

BY ROMAINE W. MYERS.

IRRIGATION PUMPING BY ELECTRIC POWER.

BY GEO. D. LONGMUIR.

FEASIBILITY OF WESTERN ELECTRO-METALLURGY.

BY DORSEY A. LYON AND ROBERT M. KEENEY.

PRODUCER GAS POWER FROM NORTHWESTERN COALS.

BY H. V. CARPENTER.

UNDERGROUND CABLE SPLICING.

BY JAMES BURNS.

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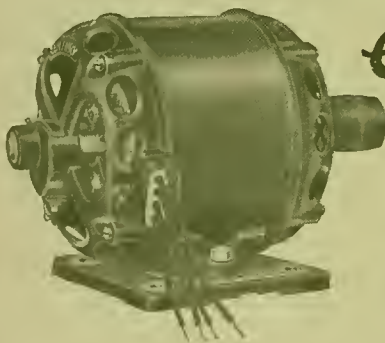
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ILLUMINATION OF OAKLAND'S AUDITORIUM

BY ROMAINE W. MYERS.

(Details are here given regarding the electrical equipment and illumination of a large public building. The author is a consulting engineer of Oakland, California, who designed and supervised the electrical installation.—The Editor.)



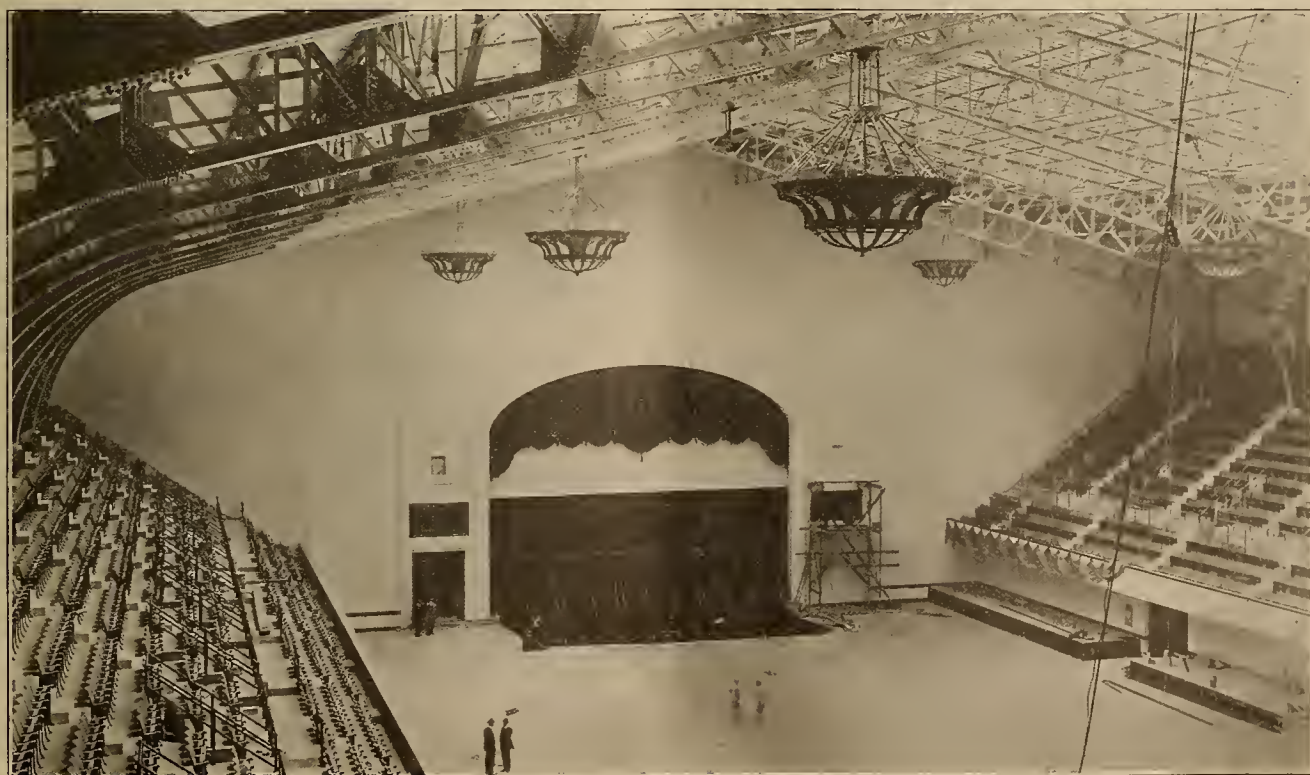
OAKLAND'S municipal auditorium in the central part of the city, faces Lake Merritt, with the Coast Range in the distance. It stands with wide open stretches on every side and a better site could not have been selected, both from the standpoint of beauty and that of utility. The building cost, exclusive of the grounds, \$1,000,000. It is of reinforced concrete.

The main facade on the north side facing the lake is faced with granite with seven niches, each decorated with bas-reliefs. It has a length of 400 ft. and a width of 200 ft. There are three stories and a basement.

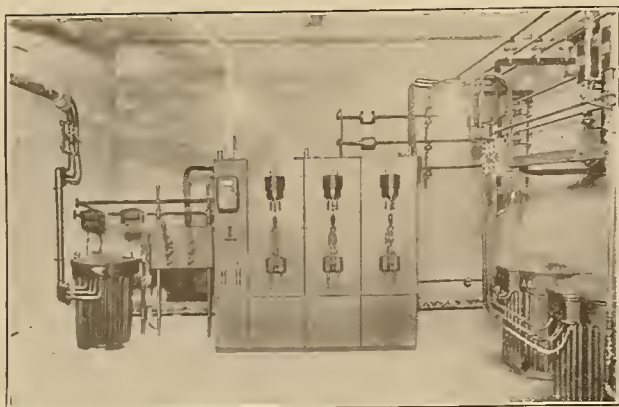
The interior of the building, on the first floor, is divided into an arena and a theatre, these having a total seating capacity of about 12,000. The arena is separated from the theatre by a stage, which can be thrown open so as to be used in common by both, or divided by a steel asbestos curtain, thus making it into two stages for use with either arena or theatre section. The arena has a clear floor space of 214 by 117 ft. and a seating capacity including balcony of nearly 10,000 people.

The theatre section has a seating capacity of 2300 and was especially designed for grand opera, theatrical productions, etc. The theatre has an orchestra pit for 100 musicians and dressing rooms for the accommodation of 200 people. There are separate entrances and ticket offices for both theatre section and arena.

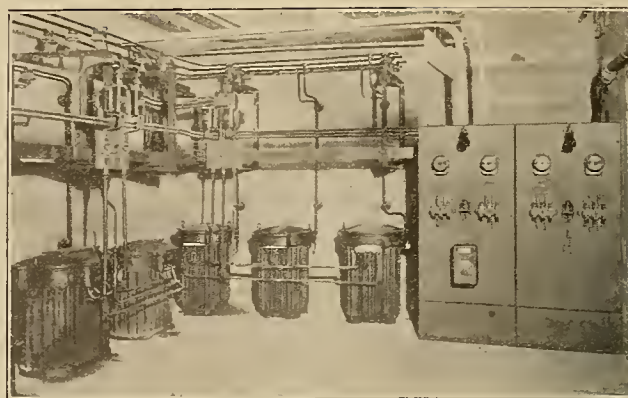
The arena and theatre balconies are reached by wide inclines rising by easy stages. The main cor-



Night Picture of Arena, showing Suspension of Semi-Indirect Fixtures.



Service Room, showing 13,000 volt Service Switch-board and Transformers.



ridor extends the full length of the building from which corridor the exits in the niches open. Between recesses of these niches are spaces utilized for exhibition booths.

In addition to the main arena and theatre section there are several rooms for smaller gatherings: committee rooms, a ball room and an art gallery. The basement space is used for storage rooms, heating and ventilating apparatus, electric lighting and power switchboards, machinery, and the balance is for use in conjunction with the arena for live stock, horses and kennel clubs and sportsmen's shows in general.

Electrical Equipment.

The electric light and power service enters the building underground in 3 in. conduits. This consists of two 3-phase 4400 volt lead covered cables, one connected to the Pacific Gas & Electric Company's hydro-electric system and the other to the steam system. This is done to insure continuity of service in case of the failure of one. There is also a 500 volt direct current service for elevators. There are few elevators in the building, as most of the floors are reached by inclines. The unusual engineering point of the service conduits is the fact that they were placed in "made" ground, the lengths being staggered and bound together by steel straps, thus making a continuous steel construction.

The service cables enter a fireproof service or transformer room, the alternating current services terminating in 13,000 volt oil switches equipped with the usual relays. These switches were installed for this high voltage so as to take care of the possible change in primary voltage to 11,000. From the oil switches the current is transmitted on insulators supported on an angle iron rack to the transformers, there being ten, having a capacity of 330 kw. This is enough for all ordinary purposes but is considerably less than the capacity of feeder cables in switchboards which are installed for a total capacity of over 700 kw. Provision has been made for setting more transformers in parallel when the occasion demands it. There are also two 3 in. spare conduits from the transformer room to the main switchboard for additional cables that may be required.

In the service room are the electric meters for the entire building. These are on a separate switchboard upon which are also located automatic control switches and relays for the emergency lighting such as exits

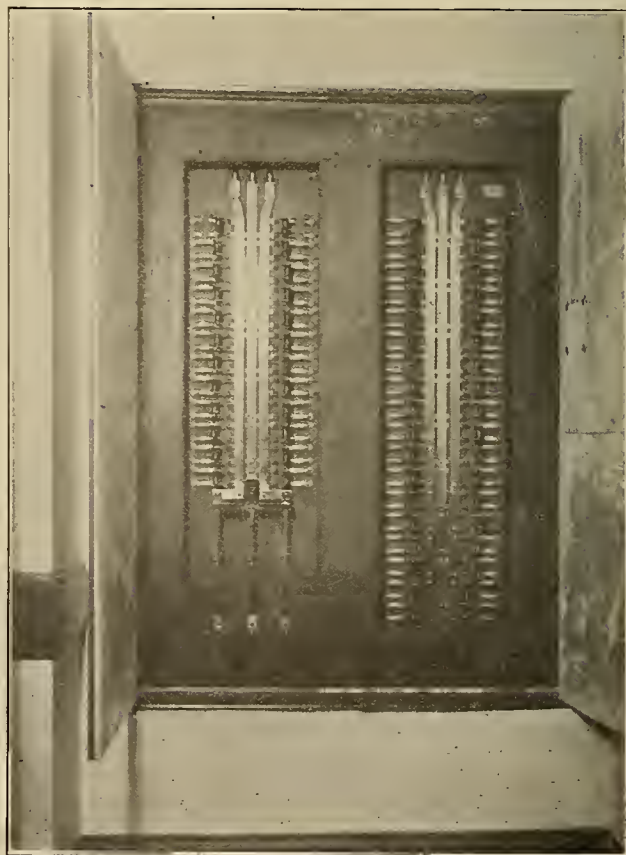
and corridors. These automatically throw the current on to another service in case of the failure of one.

From the transformers in the service room all the current, except that used for emergency lighting, is transmitted by sixteen 500,000 c.m. and five 300,000 c.m. cables to the main switchboard. This switchboard is in a concrete room under the stage.

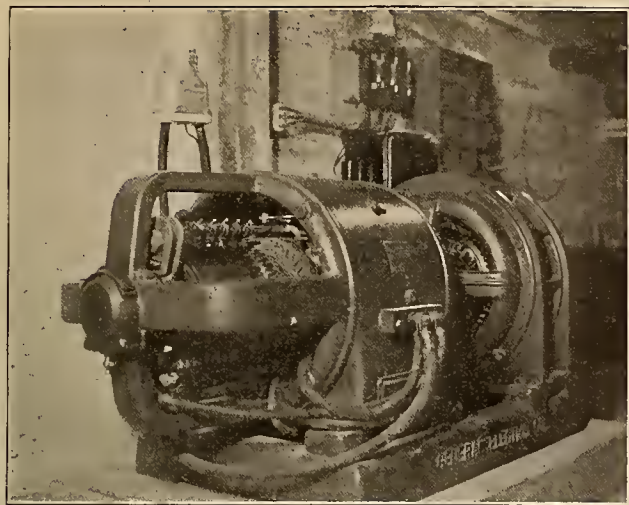
The main switchboard consists of nine panels of marine finished slate upon which are mounted switches and circuit breakers for transmitting 500 volt direct current to elevators, three-phase a.c., 220 volt for motors and 220-110 volt single-phase a.c. for lighting to the stage switchboards and various panels in the building.

These panels exclusive of the arena and stage switchboards number twenty-two, with 436 circuits.

Direct current for stage, moving pictures or search lights is supplied by a 30 kw. 125 volt General



Typical Panel Board.



Motor Generator Set, Main Switchboard Room.

Electric motor generator set in the main switchboard room. Also in this room is the arena floor switchboard. This board has a capacity of 500 kw. which is divided into three-phase 220 volt, single phase 220-110 volt three-wire and 125 volt direct current panels for supplying light and power to the arena floor.

There are twenty large junction boxes 18 in. in diameter and 8 in. deep set in the arena floor at various intervals. These junction boxes are connected together both longitudinally and transversely by means of a mass of 2 in. conduits to a large can in the rear of the arena switchboard. These conduits have no wire pulled in, the object being to provide a raceway to various points on the floor so that in case of an electrical or machinery show, it would be easy to pull in cable and connect to any current desired. Along side of these junction boxes are also placed small junction boxes for telephone and signal purposes. These are also connected together in a similar manner. A trap in the hardwood floor successfully conceals the junction boxes from view.

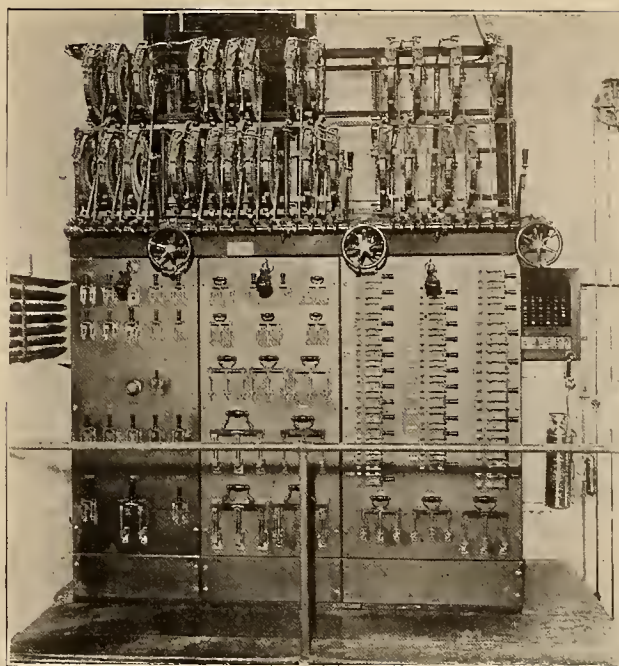
The center of the arena floor is provided with four No. 0 cables for moving picture machines. There also are twenty-two receptacles under the gallery rail and fifty-five receptacles on the main roof trusses—all of these on separate circuits—for decorative or other uses.

The arena stage switchboard and the theatre stage switchboard are on the same side of the stage directly over the main switchboard in the basement. This was economy from the electrical point of view, as it saved considerable copper.

The stage switchboards are similar, both being provided with grand master, stage and house light master, red, white and blue master and direct current master switches.

All fuses are on the rear of the boards and easily accessible. The border and pockets for theatres and arena are interchangeable, being connected by double throw switches.

In providing the light for the stage, it is necessary to take into consideration the fact that for persons in the rear of the balcony of the arena, being at a distance of over 250 ft., the amount of light used would be necessarily more than the ordinary theatre stage. With this idea in view, there were five borders in-



Theatre Stage Switchboard.

stalled, each border having reds, whites and blues consisting of three hundred and twelve 40 watt lamps; the foots having two hundred and eighty-eight 40 watt lamps. The combined capacity of pockets on stage is over 2500 amperes. The borders, foots, strips and pockets are equipped with a full set of Cutler-Hammer dimmers. Monogram act announcers are installed for each stage.

The stage manager has been provided with signals and telephones to various parts of the house and dressing rooms. The wall 'phones are Holtzer-Cabot and of a durable type, being fool proof and thief proof, which is a desirable feature in a building of this character.

The arena, including the balconies, has an area of 46,000 square feet. This is illuminated by a set of the largest semi-indirect fixtures ever built and placed in one room. These fixtures are 10 ft. in diameter, weigh over 3800 lb. each and are suspended about 60 ft. from the floor. Type "C" lamps consuming 44 kw. are used in the eight fixtures. It was necessary to provide a reflecting and diffusing ceiling for each fixture, as the clear glass ceiling of the arena could not be used for this purpose.

The average illumination upon a reading plane of the arena floor is 3.2 foot candles. The diffusion of light in this room is particularly pleasing. In a recent athletic tournament in which there were more than 2000 participants, an indoor baseball game, a basketball game and a 200 yard relay race were held simultaneously. These games were all played with apparently the same ease, as far as seeing is concerned, as in the daylight.

The theatre is illuminated by a center skylight, behind which are placed type "C" lamps and special mirrored reflectors. The ceiling decorations are brought out by means of lamps placed in a cove, some of the lamps being installed in a Mohrlite trough and others in parabolic reflectors.

The theatre has two moving picture rooms, one



Night Picture of Diffusing Sash in Theatre.

in the first and one in the second gallery. These are equipped with two Powers Cameragraph No. 6 A moving picture machines with stereopticon attachment. Each room has three 100 ampere and two 50 ampere receptacles, also 10 ampere receptacles for motors for machines and rewind apparatus.

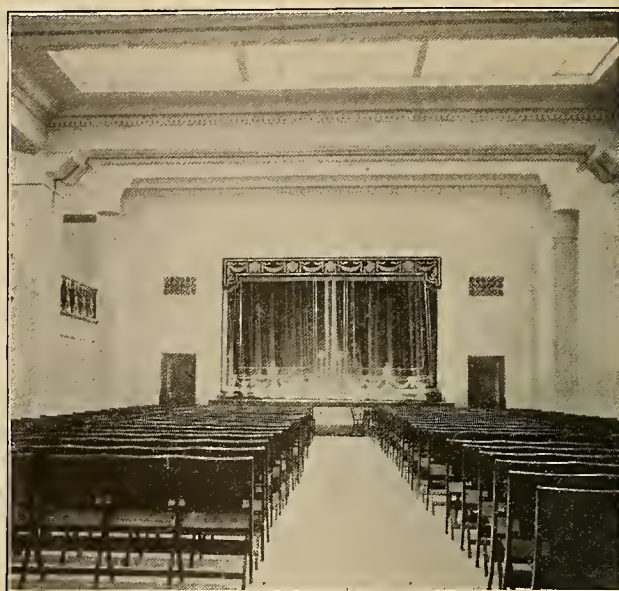
The main corridor on the north side of theatre and arena is illuminated by 400 watt Mohrlite semi-indirect units which give an average illumination on the reading plane of 4.7 ft. candles. In the exhibition booths of this corridor there are also circuits feeding twelve 50 ampere and twelve 10 ampere receptacles, thus making provision for the display of electric heating, small motors or other electric apparatus at these places. The main and second floor lobby of the theatre is illuminated by 200 and 150 watt Parian glass semi-direct fixtures. The illumination averages 2.6 and 2.5 foot candles respectively.

All inclines are illuminated by shallow Alba bowls $2\frac{1}{2}$ in. by 10 and 12 in. set in cast bronze ceiling flanges. It was necessary to provide a fixture for a minimum length due to the low ceiling height of the inclines.

On the first floor are also shower rooms, ladies' rest rooms, a press room with telephone and telegraph connection facilities for large conventions, also a kitchen which is provided with electric current for electric cooking on a large scale.



Night Picture of Main Corridor.



Art Gallery, showing Diffusing Sash.

On the second floor are committee rooms, smokers, and ladies' dressing rooms and smaller assembly rooms, the assembly rooms being equipped with facilities for moving pictures.

On the third floor is the art gallery and ball room. The art gallery is a room 36 by 110 ft. and is illuminated by Holophane reflectors above a skylight. Provision is made along the picture moulding for a large number of receptacles. These are for the individual lighting of pictures. The ball room is finished in a French gray tone and has a seating capacity of over 600 persons. One of the features of the room is a balcony overlooking the dancing floor. It is also equipped with a stage complete with curtain, border and foot lights and dressing rooms adjoining the stage. It has a kitchen which is fully equipped with a large General Electric Company electric range. The room is illuminated by Holophane reflectors placed above moss amber glass. This glass is noticeably free from spots, producing an excellent diffusion of light throughout the room. This is noticeable from the night photograph shown in this article. The illumination on the reading plane averages 2.7 foot candles. The ballroom opens out into an open air promenade and roof garden which runs the entire length of the auditorium and overlooks the lake and surrounding hills. In the center of this promenade there are two 100 ampere receptacles fed by No. 4/0 cables from the motor generator set in the main switchboard room. This current is for the purpose of searchlights or any other spectacular lighting effects that might be produced on the roof. For instance, they were used to furnish current for six 500 watt General Electric flood lighting projectors thrown on a pennant sixty feet long bearing the words "Ad Masque February 14th." This pennant was suspended from a steel cable 300 ft. long between the flag poles on the roof of the building.

The architect of the building was John J. Donovan, the consulting architect being Henry Hornbostle, and the electrical contractors NePage-McKenny Company.

IRRIGATION PUMPING BY ELECTRIC POWER

BY GEO. D. LONGMUIR.

(This interesting record of electric irrigation pumping in the Columbia River valley gives comparative costs which provide an excellent argument for power salesmen. While it deals specifically with conditions met by the Pacific Power & Light Co., from whose Bulletin this article is taken, it is applicable to many other districts.—The Editor.)

To my mind no method of demonstrating the feasibility and costs of irrigation pumping by electric or other sources of power, is as satisfactory as reciting the actual practices and results obtained in districts where such methods of irrigation are established. The following discussion will be devoted for the greater part to the actual irrigation pumping by electric power in the Columbia River valley, its resultant costs and benefits and reciting the various factors to be taken into consideration by prospective farmers and intending purchasers of pumping plants.

The Columbia River valley is favored with an inexhaustible supply of water, consequently no difficulty is experienced in obtaining water for irrigation from the rivers or from dug wells. The irrigable land in that valley, and I speak only of that portion lying between Beverly, in Grant county, and Wallula in Walla Walla county, exists on both sides of the Columbia River and totals at least 200,000 acres under a one hundred and fifty foot lift, which elevation I consider entirely practicable for pumping.

To date only a small area of this valley is being irrigated, either by gravity canal or pumping plants, but its possibilities of development, at a low cost per acre foot of water pumped, are extensive.

Before electric power was available the farmer used either a steam or gasoline engine to pump water, but at no time did he consider such a prime mover anything but temporary, as the costs of fuel in the remote districts were prohibitive and the labor of looking after his plant usually took the greater part of one man's time. Today, in being served with electric power, the farmer knows that he has at his command a source of power that is economical and dependable and in many cases he figures his power contract an asset, more valuable than any water right which he might be able to purchase.

The start in supplying power for irrigation pumping was made in a very small way, and only after careful consideration had been given the subject of rates, applicable to that class of business. Fundamentally a power company must be amply compensated for the investments which it makes for the sole use of the farmer and the revenue received must cover the fixed, or investment charges, and also the operation expense incurred in serving him. The rate established at that time, by our company, took into consideration general conditions of equity between the central station and the customer and was made up on a so-called load factor basis. This basis takes into consideration two separate elements, one taking into account the connected load, or maximum demand, of the customer's apparatus, the other, the energy used, or in other words the actual hours of use of such apparatus. We still had to bear in mind, however, that this rate must be sufficiently low to be attractive to the farmer, and at the same time, to show a saving by its use over all other sources of power competing with us. To accom-

plish this at the start meant that this class of business had to be operated at a loss for several years or until such time as we had secured a density or volume of business which would warrant the construction of the lines already installed.

The following rate, known as Schedule G, was adopted:

A fixed charge of \$12.00 per year per rated horsepower of customer's connected apparatus, to be paid in equal monthly installments, plus the following meter rates for energy used during each month:

First 30 kw.-hr., per rated kw. of connected apparatus, 3 cents per kw.-hr.
 Next 30 kw.-hr., per rated kw. of connected apparatus, 2 cents per kw.-hr.
 Next 120 kw.-hr., per rated kw. of connected apparatus, 1½ cents per kw.-hr.
 Next 240 kw.-hr., per rated kw. of connected apparatus, 1 cent per kw.-hr.
 All over 420 kw.-hr., per rated kw. of connected apparatus, ½ cent per kw.-hr.

The above rate is applicable to plants of 25 h.p. and less and the same rate applies to plants over 25 h.p. with the exception that the running charges are based upon maximum demand instead of connected load and discounts are given after certain quantities are used. We also have a flat rate of \$42 per horsepower per year where continuous operation is desired, but as 95 per cent of the small plants in my district use the metered schedule this discussion will be confined to Schedule G.

That the general construction of this rate is fair, is obvious, for it reproduces for the customer the same conditions of cost that would obtain if he were to install and operate his own generating plant. For example, a customer with a demand, say of 20 h.p. would, if desiring to supply his own needs, have to install a plant capable of meeting that demand at all times. Hence, the plant or investment charges would be proportional to the maximum demand. Furthermore, such operating costs, as labor and fuel would be proportional to the number of hours in which the demand would be used. In other words, whether the owner of an isolated plant, be it large or small, gasoline, steam or electric, knows it or not, it is nevertheless a fact that his plant serves him automatically at a load factor rate, simply because such a rate represents actual conditions of cost.

We have now been in the irrigation business a full five years and we have made substantial progress in arriving at a satisfactory solution of irrigation pumping, best adapted to that valley. During the first two or three years the conditions in the valley, under which we were forced to operate, were chaotic, in that inefficient pumping plants had been sold our customers and in many cases the outfits purchased were much too large for their particular needs, the result being a prohibitive cost for power per acre irrigated and consequent dissatisfaction with the service. To correct these mistakes the company made careful study of the situation and brought into the field representatives of standard pumps, who sold outfits under absolute guarantees of performance. The power company, at a great deal of expense to itself, installed high class units in various districts to show the farmer that with a standard pump giving reasonable efficiency very satisfactory results would obtain in operation costs. At the same time we put into the field an irrigation engineer, whose sole duty was to call upon the various farmers and aid them in every possible way, either in purchasing their outfit, or in its subsequent operation.

The result is today we have very little of the trouble we had the first few years and the plants, as a whole, are giving good satisfaction and operate with a reasonable degree of efficiency.

The farmer contemplating the purchase of a pumping plant will first want to determine the capacity of his plant and its period of operation. This capacity will depend upon the number of acres to be irrigated, the depth of water the land requires during the season, and, in the Columbia River valley, particularly, the amount of water necessary during the two months of July and August. I have found that the average farmer in that district pumps at least 40 to 45 per cent of his season's water during those two months. It will be seen, therefore, that no pump capacity, smaller than that needed to supply the necessary water running continuously for these two months, should be considered. This rule governing the capacity of a pump will hold good in nearly all cases on the large units, but it has its objections to a farmer with a small plant and a relatively small area to irrigate. While continuous pumping to him might mean a saving in power cost it would be more than offset by the increased labor costs of handling a small head of water, also the additional losses incidental thereto. Upon the smaller units, therefore, the farmer must decide for himself as to the size of his outfit and he usually does so by hitting a happy medium.

By far the most commonly used pump for raising irrigation water is the centrifugal and as, with very few exceptions, the centrifugal is the choice of all those in my district, so it will be with other in different localities where the choice lies between that and a power plunger pump, the determining factors being the capacity required and the height of lift. Centrifugal pumps owe their popularity chiefly to their simple design, small first cost and the fact that they require little attention while running. The larger sizes will, if driven at high speed, usually care for lifts as high as 100 ft. and the smaller sizes from 50 to 75 ft. In every centrifugal pump the number of revolutions of the runner or impeller has its exact relation to the elevation against which the pump is working, and for every lift there is a speed at which the pump will work most efficiently. Therefore it is of utmost importance in purchasing a pump that the exact head be given, which will include the friction as well as the vertical head. While dwelling upon the efficiency of the pump, I will add that its efficiency can be increased by reducing the friction in the suction, and discharge pipe. As few bends as possible should be used and these should be of a long radius ell. The discharge pipe should be at least one and a half times larger than the diameter of the pump outlet, and where long runs are necessary a pipe of even larger size will be economy. I have known of cases where through friction losses alone due to small pipes, twenty to twenty-five per cent more power was required.

In calculating the costs of operation of the various plants, I take into consideration all of the costs, including investment and depreciation charges, as well as operating and maintenance. To compare these costs with the cost of irrigation under gravity or pumping projects it is first necessary to take into consideration the purchase price of the water right. For example, a man buying a water right of 30 inches per year and

paying for it \$75 per acre with a maintenance charge of \$1.50 per acre, really has a total cost of \$6 interest at 8 per cent on \$75 plus \$1.50, or \$7.50. This makes his cost \$3 per acre foot.

One of the first irrigation power customers we obtained in the Kennewick valley was the owner of a 120 acre tract about one and one-half miles east of Kennewick. This plant has now been in successful operation five years, and the owner has irrigated the entire 120 acres each year, and has confined himself to raising alfalfa principally, although he has fruit trees planted which will come into bearing in three or four years. This ranch obtains its water supply from a well 28 ft. deep, 22 ft. of which is curbed, and at no time has a shortage of water ever existed.

Cost of digging well	\$ 200.00
Curbing and concrete	100.00
Pump house	350.00
Suction and discharge pipe, pump and motor.....	750.00
	\$1,600.00

Investment per acre, \$13.33.

Operating Costs.

Electric power charges, 1915.....	\$ 611.70
Interest 8 per cent on investment.....	128.00
Depreciation 7 per cent on last 3 items.....	98.00
Oil, repairs and attendance, yearly average.....	10.00

Total cost \$ 847.70

Summary of Costs and Operating Characteristics.

Average height water pumped (feet).....	26
Horsepower in-out to motor	14.3
Gallons pumped per minute.....	1050
Number of hours plant operated during season.....	3470
Total acre inches pumped, 8075, or 67 inches per acre.	
Total cost per acre, \$7.	
Cost per acre foot of water pumped, \$1.51.	
Plant operated upon an 80 per cent load factor.	

About two miles east of Kennewick, we have a customer irrigating a small tract of twenty acres, and growing strawberries, alfalfa, corn and garden truck, and this man is frank to state, that during the 1915 season, his place netted him \$1400, over and above all expenses. He has a three horsepower motor, direct connected to a 3 in. centrifugal pump, and lifts 200 gallons per minute from a well to an elevation of 27 ft.

Cost of digging well together with concrete curbing..	\$ 200.00
Pump house	50.00
Pump and motor installation.....	325.00
Suction and discharge pipes.....	50.00

Total investment \$ 625.00

Investment cost per acre, \$31.25.

Operating Costs.

Electric power charges, 1915.....	\$ 93.75
Interest 8 per cent on investment.....	50.00
Depreciation 7 per cent on last 3 items.....	29.70
Oil, repairs and attendance.....	5.75

Total cost \$179.20

Summary of Costs and Operating Characteristics.

Average height water pumped (feet).....	27
Horsepower in-out to motor	3.6
Gallons pumped per minute.....	300
Number of hours plant operated during season.....	1175
Total acre inches pumped, 787, or 39.3 inches per acre.	
Total cost per acre, \$8.96.	
Cost per acre foot of water pumped, \$2.75.	
Plant operated on 28 per cent load factor.	

This 3 h.p. plant, operated 125 hours in April; 108 hours in May; 305 hours in June; 319 in July; 222 in August; 85 in September, and 11 in October, and you will note that during June and July, over 50 per cent of the season's water was pumped.

Two miles west of Pasco, there is a large dairy and hog ranch which has had 170 acres under cultivation, consisting mostly of alfalfa and fruit. For five years previous to 1915, this ranch used a gasoline engine to pump all of its water, and for four years efforts to get the owner to use electric power were unavailing, and we always met with a response that our rates were too high. Early in 1915, however, we secured a power contract from this customer, and at the beginning of

the irrigation season a 25 h.p. motor direct connected to a De Laval pump was installed. The following information will be interesting, especially in view of the comparisons which I will draw between the costs of 1915's operation with electric, and 1914 with gasoline. This plant takes its water supply from the Columbia River, and the pump house is located just above the average high water mark.

Cost of concrete pit and pump house.....	\$ 219.00
Pump and motor	743.00
Suction and discharge pipe, estimated.....	1,200.00

Investment per acre, \$12.70.

Operating Costs.

Electric power charges, 1915.....	\$ 975.10
Interest 8 per cent on investment.....	173.00
Depreciation 7 per cent on first two items.....	67.34
Oil, repairs and attendance.....	44.10
Depreciation 12 per cent on pipe.....	144.00

Total costs\$1,403.54

Summary of Costs and Operating Characteristics.

Average height water pumped (feet).....	75
Horsepower in-put to motor.....	28
Gallons pumped per minute.....	900
Number of hours plant operated during season.....	3268
Total acre inches pumped, 6950, or 41 inches per acre.	
Total cost per acre, \$8.25.	
Cost per acre foot of water pumped, \$2.41.	
Plant operated upon 75 per cent load factor.	

The previous year, or in 1914, the investment and operating costs of the gasoline outfit, was as follows:

Cost of engine, pump and house.....	\$3,000.00
Suction and discharge pipe estimated same as electricity	1,200.00

Total investment\$4,200.00

Investment per acre, \$24.65.

Operating Costs.

Gasoline and oil, 1914.....	\$1,290.00
Labor attendance	510.00
Repairs, 1914	400.00
Interest 8 per cent on investment	336.00
Depreciation 7 per cent, pump and house.....	35.00
Depreciation 12 per cent, gas engine.....	300.00
Depreciation 12 per cent on pipe.....	144.00

Total costs\$3,015.00

Summary Costs and Operating Characteristics.

Average height water pumped (feet).....	75
Horsepower of engine	45
Gallons pumped per minute.....	1000
Number of hours plant operated during season.....	2342
Total acre inches pumped, 5100, or 30 inches per acre.	
Total cost per acre, \$17.73.	
Cost per acre foot of water pumped, \$7.10.	

This customer after only one year's operation with the electric power was so pleased with its cost of operation that he plans to irrigate 360 acres of land in 1916, and is now installing two new electric units, one of 60 h.p., and one of 35 h.p. This 35 h.p. will replace the 25 h.p. in use last season, and he figures on pumping a total of 84 inches per acre.

At White Bluffs, we have in operation three 5 h.p. plants upon adjoining ranches. During the year 1913, these three tracts secured their water from one central pumping plant and the water was delivered to the three farmers upon the rotation plan. Each man took the entire supply for three days which enabled him to get over his tract quickly with the large head of water available, and the operation of the plant represented an excellent load factor, and consequent low costs per acre for power.

The year's results affords interesting information, especially as later on they decided to operate singly, notwithstanding the higher costs of operation by so doing. In 1913 we have the following data upon the entire three tracts of land, which consisted in that year of a total of 77 acres, but as one tract of 25 acres did not come into the plan until early in June, we will call it 70 acres for the season.

Cost of 7½ h.p. motor and pump.....	\$ 400.00
Pump house	100.00
Suction and discharge pipes	800.00

Total investment\$1,300.00

Investment cost per acre, \$17.00.

Operating Costs.

Electric power charges, 1913.....	\$ 269.60
Interest 8 per cent on investment.....	104.00
Depreciation 7 per cent first 2 items	35.00
Depreciation 12 per cent on pipes	100.00
Oil, repairs and attendance.....	6.00

\$ 514.60

Summary of Costs and Operating Characteristics.

Average height water pumped (feet)	50
Horsepower in-put to motor.....	8.8
Gallons pumped per minute	350
Number of hours plant operated.....	2965
Total acre inches pumped, 2297, or 33 inches per acre.	
Total cost per acre, \$7.35. Cost per acre foot of water, \$2.67.	
Plant operated on a load factor, 68 per cent.	

This arrangement, while very pleasing in its cost per acre, especially as far as the power bill was concerned, was not satisfactory, as the different parties considered themselves deprived of the use of the water when needed badly, consequently the three 5 h.p. outfits were installed and during 1915 we have the following result irrigating a total of 87 acres:

Cost of 3 pumps and motors.....	\$1,038.00
3 pump houses	200.00
Suction and discharge pipes.....	1,200.00

Total investment\$2,438.00

Investment cost per acre, \$28.00.

Operation Costs.

Interest at 8 per cent on total investment.....	\$ 195.04
Depreciation at 7 per cent first two items.....	86.66
Depreciation at 12 per cent last item.....	150.00
Combined power bills, 1915	535.95
Oil, repairs and attention	15.00

Total costs\$ 982.65

Summary Operating Costs and Characteristics.

	Tract No. 1 27 acres.	Tract No. 2 35 acres.	Tract No. 3 25 acres.
Average height water pumped (feet)	50	50	50
Gallons per minute	250	250	225
No. hrs. plant operated	1292	1787	2864
Total acre hr. pumped.....	698	983	1288
Inches per acre	26	28	51.5
Total cost per acre.....	\$11.71	\$9.34	\$13.15
Cost per acre ft. water.....	5.40	4.00	3.10
Power cost only, per acre.....	5.93	5.05	7.95
Load factor of plant (per cent).....	30	41	66

It will be seen, therefore, that the plants operating as one unit secured a total of 33 inches of water for 70 acres at a total cost of \$7.35 per acre against the individual operations of 35 inches per acre at a total combined cost of \$11.30.

It is interesting to note that tract No. 1 and 25 acres of tract No. 2 were piped at a cost of about \$500 each to distribute the water with a minimum of loss through evaporation and percolation. Tract No. 3 has little piping and pays \$2 per acre more for power for his 51 inches than tract No. 1 did for his 26 inches. Assuming that his crops receive the same amount of water as tract No. 1, his cost will be just \$50 greater for power, and we will say that this represents his penalty through evaporation and percolation. Tract No. 1, however, has an investment of \$500, which represents a yearly interest charge of \$40, in addition to which he has a depreciation of \$62.50 or a total of \$102.50 to save the same amount of water that the other man paid \$50 for. This condition or comparison may be peculiar to these particular parties, and I will leave it with you to draw your own conclusion.

In concluding, I will state that the above named plants are representative ones picked at random from 110 customers with a connected load of over 700 h.p. Together they irrigate a total of 3500 acres and while some of them have a greater cost per acre, and some less, I consider the ones mentioned as a fair average and within the reach of all. In addition to the above, we have in my district eight large plants with a connected load of 2975 h.p. actually irrigating some 14,000 acres of land.

FEASIBILITY OF WESTERN ELECTRO-METALLURGY.

BY DORSEY A. LYON AND ROBERT M. KEENEY.

[Continued.]

Steel. As the manufacture of ferro-alloys developed, and the necessity of producing alloys of low carbon content became apparent, the design of the electric furnace was gradually altered so as to make the operation possible without a conducting carbon lining. It was only a step from the Heroult ferro-chrome furnace lined with chromite with a bottom carbon electrode, over which the metal was permitted to freeze to prevent carburization, to the non-conducting hearth of the modern Heroult steel furnace. The fundamental principles of the modern Heroult furnace were patented in 1900.

In the meantime Stassano of Italy through an interest in the carbide industry had attempted to produce steel directly from iron ore in the electric furnace with charcoal as a reducing agent. The first experiments were conducted in 1898 and were successful technically, but not as commercially because of the high cost. From these experiments on iron ore Stassano turned to the development of his furnace for the manufacture of steel from scrap iron and scrap steel, and he had a furnace operating for this purpose at Turin at the time of the visit of the Canadian Commission in 1904. This furnace was similar to the modern Stassano electric steel furnace.

The application of the induction principle to the manufacture of steel was begun not because of an overdevelopment of any electric furnace industry, but because of actual need of such a furnace in steel manufacture. In 1899 Kjellin, a Swedish electrical engineer, was requested by the works manager at Gysinge, Sweden, to construct an electric furnace. The furnace was to be used for the production of the highest grades of tool steel from Swedish iron. As Kjellin did not approve of the arc furnace because of possibility of contamination by the electrodes, the furnace was based upon the induction principle. In March, 1900, the first steel ingot was cast. In fundamental principles the first furnace was practically the same as the modern Kjellin electric steel furnace.

During the trip of the Canadian Commission of 1904, experiments on the manufacture of steel from scrap steel and iron were made in the Kjellin furnace at Gysinge, Sweden, and the Heroult furnace at La Praz, France. The conclusions reached in 1904 by Harbord, the metallurgist of the commission, in respect to the electric production of steel, were as follows:

1. Steel equal in all respects to the best Sheffield crucible steel can be produced either by the Kjellin or Heroult processes at a cost considerably less than the cost of producing high class crucible steel.

2. Structural steel to compete with Siemens or Bessemer steel can not be economically produced in electric furnaces and such furnaces can be used commercially only for the production of exceptionally high class steel for special purposes.

In connection with the development of the Girod ferro-alloy works at Ugine, France, Girod had devised an arc with a non-carbon-conducting hearth that was used for the manufacture of low-carbon alloys. As the ferro-alloy industry became well established, Girod

turned his attention to a steel furnace, and in 1905 constructed a furnace based upon the principles of the earlier ferro-alloy furnace.

After the introduction of the non-carbon-conducting hearth in 1905, other furnaces similar to the Girod were developed. The Keller and Gronwell furnaces both have a non-carbon-conducting hearth. Nathusius built a furnace combining the arc and resistance principles. Other furnaces of the arc type which have been designed and built since 1904 are the Anderson, Chaplet and Soderburg furnaces.

The Rochling-Rodenhauser electric steel furnace was developed from the original Kjellin induction furnace in 1906 to meet the requirements for refining molten basis Bessemer steel. It is the most widely adopted induction furnace of the present time. Other induction furnaces are the Frick, the Hireth and the Paragon furnace of Harden.

Electric copper smelting. Development of the electric smelting of copper ores has been very slow, due to the fact that there has been very little need for much development along this line, considering the low cost of combustion furnace copper smelting in most mining districts. Electric copper smelting would be successful commercially only in mining districts where the ore supply was so located as to make coke very expensive and where electric power could be developed very cheaply. There have been several experimental runs made on electric smelting of sulphide, oxide and native copper ores.

Vattier conducted experiments for the Chilean Government in 1903 at the works of Keller, Leleux & Co., Livet, France. The test was conducted on a commercial scale using a furnace with a capacity of 25 tons of ore per 24 hours, requiring a steady load of about 700 horsepower on the furnace. Sulphide and carbonate ores were smelted. While the run was successful technically, a matte containing 48 per cent copper being produced by careful mixing of the ores, the cost of smelting was found to be high.

Schilowski and Wolkoff have recently conducted small scale experiments on electric smelting of sulphide and oxide ores of copper, but no definite conclusion can be drawn from their work.

Stephan, superintendent of the Girod electric steel works at Ugine, France, reported some experiments of his in 1913, in which Belgian Congo oxide ore of copper was smelted to produce copper bullion in a furnace similar to the Girod ferro-alloy furnace. The experiments were apparently successful for oxide ore. Sulphide ore was not smelted.

In 1913 we conducted a series of experiments for the U. S. Bureau of Mines on the electric smelting of native copper concentrates and sulphide ores of copper. The work was done in a 60 horsepower furnace and considerable data obtained showing what might be expected technically in electric copper smelting and general figures as to cost of smelting. From a technical standpoint it was evident that no greater difficulties would be met with the electric furnace than with the combustion furnace. But commercially it is clear that electric copper smelting can only be used to advantage in place of combustion furnace smelting where coke is very expensive and electric power very cheap.

Electric zinc furnace. The use of the electric furnace in the metallurgy of non-ferrous metals has had

greater application for the treatment of zinc ores than is the metallurgy of any other of the non-ferrous metals except aluminum and ferro-alloy manufacture. Since 1885, when an electric furnace for the treatment of zinc ores was patented by Cowles Bros., experimental work has been conducted on this subject. The commercial application of the process, however, has not resulted to any great extent because of the difficulty of condensing zinc vapor produced under the smelting conditions of the electric furnace. The cause of this difficulty has not yet been definitely determined. With few exceptions the experimental work has not been conducted on a very large scale, and so it may be said that the electric smelting of zinc ores is still in the experimental stage, although it is more advanced than electric smelting of copper ores.

For several years experimental work on a laboratory scale has been conducted at McGill University under the direction of Dr. A. Stansfield and W. R. Ingalls. This experimental work has been largely directed toward a study of the condensation problem and the speed of reduction.

One of the most persistent investigators of the possibility of smelting zinc ores in the electric furnace is W. McA. Johnson of the Johnson Electric Smelting Company. He has conducted experiments on a large laboratory scale for several years. As a result of the success of these experiments, a small commercial plant is now being installed at Keokuk, Iowa.

The experimental work performed with the De-Laval furnace has resulted in the establishment of a large electric smelting plant at Trollhattan, Sweden. Zinc smelting has been conducted at this plant for six or seven years, but part of the product has been the result of refining dross and scrap.

All of the people mentioned above in connection with electric smelting of zinc ores have used an electrode furnace and carbon as a reducing agent. The ore was roasted previous to smelting for removal of sulphur. There have been two exponents of the use of iron as a desulphurizing agent in electric smelting of zinc sulphide, i.e. the Imbert and Cote-Pierron processes. Imbert tried out the reaction without much success in the combustion furnace. Thomson and Fitzgerald later designed an electric furnace for its application. After testing the Imbert-Thomson-Fitzgerald process for several years in Upper Silesia, it has apparently proven unsuccessful, as further work is not being done. Resistance furnaces were used which did not appear to have very high thermal efficiency. In the Cote-Pierron process an electrode furnace is used. The process did not appear successful from the first work done due to condensation difficulties, but it was recently reported that a small plant was being erected in France.

Present Commercial Status of Electrometallurgy.

Aluminum. All aluminum manufactured today is produced by an electrometallurgical process, either by the Heroult process or the Hall process, both of which are essentially the same. In the United States the Hall process is used and in Europe the Heroult process.

The production of aluminum in the United States has not increased materially since 1912, but exact figures are difficult to obtain, owing to statistics

being given for recent years as consumption. The consumption in 1913 amounted to 72,379,090 lb., of which probably about 30,000,000 lb. was imported during the calendar year. Importations during the year ending June 30, 1913, amounted to 26,642,112 lb., and imports were increasing at the end of that period. The actual production for 1913 in the United States may be roughly estimated at 42,000,000 lb. In 1907 60,000 h.p. was being utilized in the manufacture of aluminum in the United States. Today probably 80,000 h.p. is in use for this purpose.

Up until recently the production of aluminum in the United States was entirely controlled by the Aluminum Company of America, owners of the Hall patents, which have now expired. In this country this company has one plant in operation at Niagara Falls, N. Y., and one at Massena, N. Y., as well as one in Canada at Shawinigan Falls. The company plans the construction of a plant at Marysville, Tennessee, where there is reported to be a possible power development of 100,000 h.p.

On the expiration of the Hall patents in the United States, a company was formed by French financiers interested in the Aluminum Francaise under the name of the Southern Aluminum Company. A plant is in course of construction at Whitney, North Carolina, on the Yadkin River, where a total development in high water of 100,000 h.p. is possible, although the average power will be about 45,000 h.p. The capacity of the plant to be erected will be 20,000,000 lb. of aluminum per annum.

In Europe the aluminum industry has progressed as rapidly as in the United States. From the table below, Europe in 1912 produced about three and one-half times as much aluminum as the United States, but this country leads in individual production, with France second.

*World's Production of Aluminum in Metric Tons (2204 lb.)

	1910	1911	1912
United States	16,100	18,000	18,000
Canada	3,500	2,300	8,300
Germany	8,000	8,000	12,000
Austria-Hungary			
Switzerland			
France	9,500	10,000	13,000
England	5,000	5,000	7,500
Italy	800	800	800
Norway	900	900	11,500
Total	43,800	45,000	61,100

*As reported by Metallgesellschaft, Frankfurt A. M.

There are five large companies producing aluminum in France in connection with the manufacture of other electrometallurgical or electrochemical products, such as ferro-alloys, electric furnace steel, calcium carbide, chlorates, sodium, potassium and cyanides. As all of these companies manufacture numerous products, it is impossible to segregate the capital invested in each or the power consumed, but practically all of the French aluminum is made by these companies which sell their product through a syndicate called Aluminum Francaise.

It is probable that there will be a large increase in the aluminum production of Norway very shortly, as one English company has recently completed a plant of 2000 tons annual capacity at Vennesla, near Christianssand, and a Norwegian company has almost completed its plant near Arendal at Eydehaven, which when working full will take 25,000 h.p.

(To be continued.)

PRODUCER GAS POWER FROM NORTH-WESTERN COALS.

BY H. V. CARPENTER.

(A brief report is here given of the adaptability of Washington coals for more efficient utilization in the gas producer. This paper is taken from the Journal of the Oregon Society of Engineers. The author is professor of mechanical and electrical engineering at Washington State College.—The Editor.)

The production of producer gas is fundamentally a very simple process. Any coal or wood fire which has too small an air supply generates partially burned gas which might be called a poor grade of producer gas. Control of the thickness of the fire and the addition of a little steam greatly improves the gas until it yields about one-quarter as much power as first-class city gas. The easy control, continuous process, and the fact that as high as 90 per cent of the heat of the coal can be delivered in the gas makes this method one that is growing in favor as its uses and behavior become better known. If the gas can be used hot from the producer, as in special furnaces in many manufacturing processes, there is less waste of heat than is common in furnaces fired directly with coal and much better and more convenient furnace control results. Used in gas engines for power the engine draws its own gas supply from the producer, the engine itself is simple in design and its use involves no unusually high pressures or temperatures which are so fatal to long engine life and reliability.

Another interesting characteristic of the gas producer is the fact that it is frequently able to utilize to good advantage fuels which are not of much value for domestic use. In fact, many varieties of coal that are not successful competitors with other kinds for use in large steam plants will give good results in producer work. The lignites which are high in ash and moisture and low in fixed carbon are usually too flashy and break up too much for good service elsewhere but in the producer can generally be handled easily and with good efficiency. Coals which clinker badly will give trouble in the producer, though some coals will clinker in the very hot fires under large steam boilers which will not bother in the producer when properly handled. A non-coking coal requires less poking and is usually used in preference to a coking coal, in part perhaps, because the steam plant will usually pay most for the coking coal.

It is reported that an enterprising Englishman has an automobile driven by its own producer and engine. The engineers in this country have been quite conservative in the sizes and types which they have attempted to build, limiting them to sizes of 50 h.p. and over. This seems to be due more to the fact that the producer gas equipment requires competent attendance than to any very great difficulty in making smaller units run successfully. The saving in attendance will usually make the gasoline engine most economical in sizes where the fuel consumption is not of vital importance. One of the peculiar properties of all gas engines as compared with steam engines is their comparatively high efficiencies in small sizes. This leaves the best field for the producer plant in the middle sizes of from 50 h.p. to 1000 h.p. because in very

large sizes the modern steam turbine has no competitor when first cost and over all efficiency are considered. In this middle field the producer engine can give very good service. Especially when near a cheap supply of suitable coal and when steady and long-continued loads are to be carried. The producer gives very little difficulty in starting and stopping and the standby losses are small since the fire pot is so built that the fuel can be made to hold the fire a very long time. Steady loads are, however, necessary, if good showings for economy are to be made, because the first cost of the producer equipment including all auxiliaries is quite high, so that it cannot be used for loads that are to be carried only a short time during the year.

For the past five years a series of tests have been carried out at the State College of Washington mainly for the purpose of determining the adaptability of the many kinds of coal in the Northwest for producer practice. The principal value of the tests have been in showing that most of the different fields produce coal that will behave well in the producer. If a coal handles easily and is cheaper than any other of similar heating value it is quite likely to prove the most economical for use, so we have not laid great stress on exact determinations of efficiency although many such tests have been made. The tests indicate that general statements may quite safely be made as to the adaptability of the coals from different districts without specifying any particular mine. Repeated attempts to use coal from the Roslyn field have all failed to give good results mainly because of clinkers and trouble in keeping the fuel bed uniform enough to give good gas.

Coal from the Mendota and Carbonado districts of western Washington have been tested many times and always without trouble. The Mendota coal carries more moisture than any other tested and so required less steam to make good gas.

Several tests have been made on the coals from Wyoming which are common in eastern Washington markets. All of these have given good results and practically no trouble in handling.

Only one Canadian coal, the "Hill Crest," has been tried. This is a coal with much higher fixed carbon than the successful Washington coals but gave fairly good results even though the coal used would be classed as screenings. This coal in pea size or larger would give good results.

The results may apparently be summed up by saying that any of the free-burning western coals which do not clinker in ordinary firing will work well in the gas producer. The amount of coal used in these tests has varied from 1.78 lbs. to 2.6 lbs. per h.p. per hour which would indicate very satisfactory results in larger plants. The producer used was a Smith down draft type, with automatic steam control and mechanical scrubber. Little trouble has been had with tar reaching the engine, and with a good coal the quality of the gas has not been hard to maintain. More trouble has been experienced with the ordinary mechanical difficulties with the engine and auxiliaries than with the producer. It should be said that when the troubles common to any gas engine and the

peculiar characteristics of the producer are considered it is probably necessary to supply a little better grade of attendance than would be needed for a steam plant of the same size. This difference is not great, however, for we have trained several men to handle the plant with no very great trouble. These results prove that there are many conditions and localities, particularly in western Washington and Oregon, where the producer plant will prove to be entirely satisfactory both in economy and reliability.

UNDERGROUND CABLE SPLICING.

BY JAMES BURNS.

(This brief account of approved practice is taken from the bulletin of the Pacific Light & Power Company of Los Angeles, with which company the author is connected in the underground cable department.—The Editor)

Ten years ago practically all of our underground cables were rubber covered, taped and jute braided. Today almost 75 per cent of this cable has been replaced with paper insulated lead sheath cables. We have standardized on this class of cable.

The rubber covered cables were spliced by stripping $1\frac{1}{2}$ in. of rubber from the end of each cable, then removing one inch of the outside braid and tape so that when insulating the joint the rubber wrapping tape would vulcanize with the black rubber insulation of the cable. The conductors were connected with a 3-inch copper sleeve, tinned and sweated on the conductor, then insulated with rubber wrapping tape according to the operating voltage of the cable, a binding of friction tape and a double layer of P. & B. tape finishing the splice. In the old redwood duct section of our underground system it was very difficult to make these joints so as to be thoroughly electrically insulated.

In connection with the paper insulated, lead covered cables, there are many different kinds and sizes of splices, depending on the voltage of the cable and the size of the conductor. The most common splices in our system are made on single conductor, duplex conductor and three conductor cables. Under ordinary circumstances prepared paper tube insulators are used. The tube is built up of laminations or layers of paper, spirally wound, forming a tube, the insulating being equivalent to the insulation of the cable on which it is used. It is then impregnated with a moisture proof compound and sealed with paraffine. In preparing for the splice seven inches of lead sheath is stripped from the end of one cable, four inches of lead sheath is stripped from the end of the other cable. One of these paper tubes is slipped over each conductor of one of the cables. A 12-inch lead sleeve having a diameter of about two times the diameter of the cable is slipped over the sheath of the other cable. The conductor is spliced with a copper sleeve $2\frac{1}{2}$ in. long, slipped over the ends of the conductor of both cables and carefully soldered. The paper insulating tubes are then slipped back over the copper sleeve and tied with linen tape. The lead sleeve is then slipped over the entire splice, both ends dressed down to the outside diameter of the cable and a joint is wiped, soldering this lead sleeve to the sheath of each of the cables. The wiping of this joint is one of the most particular operations of

the splice. In some instances the splicer juggles, in the operation, as much as 12 pounds of molten solder on a wrapping cloth of 6 or 8 in square. When the solder has cooled a fill hole and a vent hole is cut in the lead sleeve. The sleeve is then filled with a boiling insulating compound. We use, for this operation, a compound known as "Ozite." This compound thoroughly fills the sleeve, preventing the possibility of moisture entering the cable in the event of a pin hole either in the wiped joint or the lead sleeve itself. In many instances conditions are such that the paper insulating sleeve cannot be used and in its place there is substituted tape insulation, which is wrapped on the splice spirally. In this operation extreme care must be exercised, and it requires about three times the labor and time to make such a splice.

To splice single conductor cables the operation is practically the same, but due to the fact that we have only one conductor to work with, the operation is much simpler and the lead sleeve itself considerably shorter. In many instances splices must be made on all classes of cable without interrupting service, and jumpers are used to conduct the current around the splice and the splice is made with the full potential on the conductor at all times. Such a splice on a 2400 volt primary cable is a common occurrence, the splicer using rubber gloves and other protective devices to insulate himself from the ground and from the other conductors.

The 15,000 volt splice is made by removing 10 in. of lead armor from one of the cables and 6 in. of lead armor from the other. The outer binder or belt of the paper insulation is removed within two inches of the armor. It is square and left for a heel. The conductors are separated and paper insulating tubes are placed over each conductor of one of the cables. A $3\frac{1}{2}$ in. paper tube is placed over the conductors of the other cable. The operation of splicing the conductors with copper sleeves is performed and a single layer of empire cloth tape is wrapped over the copper sleeve, the tubes slipped back over the splice and tied in place with linen tape, the large tube slipped back over the entire splice and securely bound with linen tape. A 6 in. lead sleeve 20 in. long is split and placed over the splice, dressed down to fit the cable wiped to lead sheath of each cable and the filling operation is performed.

The latest splice which we have been called upon to make is an insulated joint placed in the lead sheath, sectionalizing various districts and breaking up the flow of stray currents in the armor of the cable. This is made by cutting out 1 in. of the lead armor of the cable, taping the same with insulating tape. Over this is placed a 3-in. fibre sleeve 4 in. long, which has been tongued and grooved to a perfect fit. A split lead sleeve is dressed down to fit this fibre sleeve and wiped to each cable. Two iron bands are clamped around the lead sleeve and $1\frac{1}{2}$ in. of the sleeve is cut away. The entire sleeve is then filled with insulating compound.

In my opinion splices such as I have described are electrically the best insulated part of the cable. In all of our cable failures not over one or two can be traced directly to the splice, and in these instances negligence was probably the cause of the failure.

JOURNAL OF ELECTRICITY

POWER AND GAS

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Considerable criticism has always been made regarding the comparative neglect of means for promoting industrial and engineering research in America. Germany's great industrial advances were largely due to government aid and encouragement in this direction. Consequently it is of interest to learn that a bill has been introduced in Congress by Senator Newlands of Nevada providing for the establishment of engineering experiment stations in the several land grant colleges. In general the bill is intended to promote the purposes as outlined in an editorial in these columns some months ago, the specific aims being detailed as follows:

To conduct original researches, to verify experiments and to compile data in engineering and in the other branches of the mechanic arts as applied to the interests of the people of the United States, and particularly of such are engaged in the industries; also to conduct researches, investigations and experiments in connection with the production, transportation, extraction and manufacture of substances utilized in the application of engineering and of other branches of the mechanic arts to industrial pursuits; water supplies as to potability and economic distribution; sewage purification and its ultimate inoffensive disposal; economic disposal of urban and manufacturing wastes; flood protection; architecture; road building; engineering problems connected with transportation, manufacturing and public utilities; and such other researches or experiments bearing directly on the various industries and occupations of the people of the United States as may in each case be deemed advisable, having due regard to the varying conditions, resources and needs of the people of the respective states and territories.

The sum of fifteen thousand dollars is provided for the prosecution of the study in each college, the general supervision of work resting with the Secretary of the Interior. Bulletins are to be published at least semi-annually detailing results accomplished.

Heretofore there has been too little appreciation of the necessity for co-ordinating science and industry on national lines. The layman is just awakening to the tremendous importance of applied science in warfare but does not yet seem to realize that in the industrial and commercial struggle that will inevitably succeed the war science will play an equally important part.

Money appropriated for research purposes has proven to be one of the soundest forms of national investment. The cash value of scientific research is cumulative and yet science has usually been denied the common privilege of all commercial pursuits,— participation in profits. It is an elementary rule of business that part of the profit shall flow back into the business to be devoted to the production of future output. While science has given incalculable sums of money to the world it is left to maintain itself on little or nothing. Not one-millionth of all the wealth which Faraday poured into the lap of the world has ever been returned to science for the furtherance of its aims and achievements, for the continuance of research

The supply and training of competent research workers can only be secured through the system of public education. The English National Board of Education has recently approved a plan for the administration of government grants for scientific research and the example should be followed by the United States.

Whatever action is taken to secure a more uniformly higher standard of electrical equipment in buildings is commendable, but for many years so much has been essayed sectionally along this line that the time has now arrived when collective effort is seen to be essential for the complete success of the plan.

Eliminating the "Electrical" Architect

Various factors are involved, the most important of which are the determination of standards, the assurance of their acceptance, together with an insistence upon work being carried out in accordance with the standards thus set.

Pacific Coast associations of electrical contractors and dealers affirm truly that the success of their plans along this line hinge largely upon securing the fullest possible co-operation of architects, but it is equally true that the owners of prospective buildings must be influenced into acceptance of high standards and it will be found that the architect must be compelled to surrender the determination of the electrical requirements of buildings to electrical experts.

The only satisfactory co-operation that can obtain will be between the architect and his electrical engineer for the drawing of electrical equipment specifications of buildings is just as much the work of an engineer as for those covering steel construction, heating and ventilation and plumbing. But to get this fact universally and rapidly recognized will take more than an occasional lecture before architectural societies and the distribution of typical modern electrical specifications to individual architects. That plan has proven inadequate in the past. Just as none but a qualified architect would be permitted to plan any noteworthy edifice so this situation too calls for the recognition of the electrical engineer.

Sectional effort is commendable as far as it goes, but the need now calls for real co-operative effort by a joint committee of electrical and architectural interests.

Legislation has been enacted which prevents the quack doctor from preying upon the unsuspecting. What is admittedly wrong in other spheres of action cannot be justified in the electrical. The electrical equipment of buildings must be made safe, suitable, and satisfactory.

The electrical engineer, in co-operation with others interested, should rise to the occasion and urge upon administrative bodies the importance of his profession in this particular. If it is not permissible or ethical for him to prepare building plans and specifications so likewise it should be made impossible for the architect to invest himself with authority to bungle the work which rightly belongs to the electrical engineer.

Since educational measures have failed, more

radical means must be adopted that the "electrical" architect shall exist only as an undesirable memory of the past.

That a successful business can be built only upon a firm foundation of confidence seems so self-evident as to require no demonstration. The transaction of all business requires that men trust each other. Credit depends absolutely upon confidence.

The Mutuality of Confidence

While in this narrow sense the importance of confidence is well recognized in its broader meaning of mutual faith it is sometimes overlooked. To inspire trust in others a man should place his faith in others. People do not believe in him who does not believe in them. While a public service corporation, for example, is jealous of maintaining the confidence of business men it is sometimes careless in retaining the confidence of its consumers.

Confidence begets confidence. So in spite of criticism, notwithstanding the imputation of false motives, it behooves the management of public utilities to hold to that fine faith in human nature that in every human being there is a sense of justice and fair-play which can be appealed to by fair treatment and quiet suggestion. Such confidence engenders public respect, that quality that causes others to unquestionably accept one's statements. It comes only as a result of hard, faithful work, for confidence is a plant of slow growth and requires careful cultivation.

Since the publication of an editorial in these columns entitled "What is an Engineer," the Carnegie Foundation for the Advancement of Science has requested various engineers throughout the country to express their opinion of its summation of those qualities which constitute an engineer. It will be remembered that these included character, judgment, efficiency, understanding of men and technical ability, each qualification being given a percentage rating.

As, on this basis, it would be theoretically possible for a man with no knowledge of the fundamentals of engineering science and having no technique of practice and of business to have a rating of 87 per cent, the suggestion has been made by a number of engineers that any such weighted rating of the relative importance of these several constituents of success is misleading. Each element is essential to that composite man known as an engineer, just as fuel, oil, water, furnace, tubes and stock are necessary to give a boiler. It is like the fable of the quarrel among the several parts of a clock—each is indispensable to its operation. Without any one of them the clock will not go.

The value of an engineer, then, depends upon the degree to which he possesses all these essentials. Lack of any one of them, or even a marked deficiency, would disbar a man from the category. This suggestion seems to be more nearly in accord with actual estimates of an engineer's ability and should be considered in the final definition formulated.

Defining an Engineer

PERSONALS

E. L. Dixon, manager of the Mohrlite Company, will visit the Pacific Coast early in April.

John P. Bell, Pacific Coast manager Standard Underground Cable Company, is at Los Angeles.

A. J. Meyers, Pacific Coast manager of the Wagner Electric Manufacturing Company, is at St. Louis.

E. D. Farrow, commercial agent of the San Joaquin Light & Power Company, is at San Francisco.

W. S. Berry, sales manager of the Western Electric Company at San Francisco has returned from Honolulu.

G. P. Lundle of the Tonopah Tire & Electric Company of Tonopah, Nevada, is here on a short business trip.

W. Brewster Hall, Pacific Coast manager Pass & Seymour, has returned to San Francisco from Solway, N. Y.

C. O. Poole, chief engineer Southern Sierras Power Company of Riverside, Cal., was at San Francisco last week.

Jos. Thieben, general manager, Panama Lamp Company, has returned from an extended business trip in the East.

C. F. Fairly has been appointed Northwest representative of the Kellogg Switchboard & Supply Company with offices in Portland.

E. W. Davies, Pacific Coast agent for the Usona Mfg. Co. Kwik-lite products, has returned to San Francisco from a short trip in the south.

H. A. Lardner, vice-president of the J. G. White Engineering Corporation, recently returned to San Francisco from an extended trip in the East.

Geo. R. Murphy, soliciting agent of the Electric Storage Battery Company of Philadelphia, is making a business trip throughout the Northwest.

H. J. White of the Keeler, White Company, electric manufacturers' agents on the Pacific Coast is making a business trip throughout the south.

E. B. Walthall, assistant general manager of the San Joaquin Light & Power Company, of Fresno, California, spent a few days last week at San Francisco.

John E. Kelly, motor department of the Sheldon Electric Company of New York, in company with **Allyn T. Doty** of the same company, are at San Francisco.

W. P. Naser, manager Trumbull Electric Manufacturing Company, San Francisco, has returned to San Francisco from the Oregon and Northern California territory.

T. E. Nivison has been made manager of the Portland office of the Federal Telegraph Company, succeeding **R. D. Gould**, who returns to his home in Denver.

B. F. Oakes, president of the American Ever Ready Company, of the National Carbon Company, recently left San Francisco for a three weeks' business trip in the East.

K. Mamamoto, engineer of the Nippon Oil Company, Ltd., Tokyo, Japan, in company with **D. Matsuzawa** engineer, and **K. Ito**, secretary of the same company, are at San Francisco.

J. D. Scott, formerly power salesman with the Portland Railway, Light & Power Company, has been appointed assistant engineer in the office of **O. B. Coldwell**, general superintendent of the company.

W. W. Lowe, president of the Electric Appliance Company of Chicago, who has been on the Pacific Coast for the past two weeks, returned to Chicago via Los Angeles, Dallas and New Orleans.

A. T. Menzel has resigned from the engineering department of the General Electric Company at San Francisco

to become superintendent of the power plant at Big Bend, with the Great Western Power Company.

Walter C. Clark, electrical engineer Bunker Hill & Sullivan Mining & Concentrating Company, read a paper on electricity as applied at their properties before the Northwest Mining Convention at Spokane, March 21.

Wm. T. Wallace, author of the article on Irrigation Pumping in Idaho, which appears in the March 18th and 25th issues of this journal, is vice-president and general manager of the Electric Investment Company, of Boise, Idaho.

Miss Eugenia Galvin, electric range expert, has returned to San Francisco, after spending eight days in Mountain View, Calif., where she sold twenty Westinghouse automatic electric ranges and as many electric water heaters.

M. L. Joslyn, president of the Baker-Joslyn Company of San Francisco and also president of the Joslyn Manufacturing & Supply Company of Chicago, who has been visiting the Coast for the past few weeks, has recently left for Chicago via Los Angeles.

F. H. Murphy, illuminating engineer Portland Railway, Light & Power Company of Portland; **F. H. Osborn**, professor of physics, University of Washington, Seattle, and **Alexander Macbeth**, vice-president and general manager Southern California Gas Company, Los Angeles, have been transferred to the grade of member of the Illuminating Engineering Society.

N. G. Warth has been appointed general manager of the Interstate Utilities Company, operating telephone properties in Northern Idaho, vice **J. H. Morgan**, resigned. Previous to accepting this position Mr. Warth was connected with the Central Union Telephone Company and more recently was division manager of the American Telephone & Telegraph Company at Columbus, Ohio.

James B. Olson, recently appointed general sales manager of the Habirshaw Electric Cable Company, Inc., of New York, formed by the consolidation of the Habirshaw Wire Company, the Electric Cable Company and the Waterbury Company, has been well known in the electrical wire and cable business for many years. He entered this field as a young man with the New York Insulated Wire Company, later connecting himself with the Habirshaw Wire Company and acting as salesmanager for the past eighteen years.

COMMITTEE ON ELECTRICAL SAFETY RULES.

The California Industrial Commission has appointed a committee to consider tentative rules of the U. S. Bureau of Standards with a view to formulating rules to govern electrical installations in California. Following is the personnel of the committee: Chairman, **S. J. Lisberger**, engineer of electrical distribution, Pacific Gas & Electric Company, representing the National Electric Light Association, San Francisco section; vice-chairman, **J. M. Barry**, chief of department of electricity, city of San Francisco; **F. Emerson Hoar**, gas and electrical engineer, State Railroad Commission; **John Hood**, General Electric Company; **Carl E. Hardy**, superintendent of electrical department, city of Oakland; **H. C. Reid**, Pacific Fire Extinguisher Company, representing the California Association of Electrical Contractors and Dealers; **J. Mergenthaler**, representing Pacific District Council, International Brotherhood of Electrical Workers; **H. M. Hansen**, business agent of local union, No. 404, International Brotherhood of Electrical Workers; **Arthur Elken**, representing local union, No. 6, International Brotherhood of Electrical Workers; **W. H. Urmy**, representing local union, No. 6, International Brotherhood of Electrical Workers; **George Sorenson**, secretary of local union, No. 537, International Brotherhood of Electrical Workers; **Max A. Schmidt**, superintendent of electrical equipment, Schmidt Lithograph Company, representing the California Employers' Federation; **Robert L. Eltringham**, electrical engineer, Industrial Accident Commission of California; secretary, **John R. Brownell**, superintendent of safety, Industrial Accident Commission of California.

MEETING NOTICES.

Los Angeles Section American Society of Mechanical Engineers.

At the March 28th meeting W. H. Clapp will give a talk on motor trucks in Southern California. The section holds a lunch meeting every Thursday at the Hotel Hayward Cafe, Sixth and Spring streets at 12 noon.

Oregon Society of Engineers.

The regular monthly meeting was held in the grill room of the Oregon building, Portland, Oregon, March 20th. W. S. Turner, president, presided at the informal smoke during which a free lunch was served. In the course of the evening John Lyle Harrington, consulting engineer, in charge of design and construction of the Columbia River bridge gave a talk illustrated by plans, photographs and lantern slides of the bridge.

California Association of Electrical Contractors and Dealers.

A quarterly meeting of the California Association of Electrical Contractors & Dealers will convene April 6th at the Hotel Oakland, Oakland, Cal., 1:30 p. m. A meeting of the executive committee will be held 10:00 a. m., April 6th, at the offices of the Alameda county section of the association. The regular monthly meeting and dinner of the association will be held Thursday evening, April 6th, 7 o'clock, Hotel Oakland, corner of Thirteenth and Harrison streets. All members of the association, jobbers and their salesmen and central station representatives are requested to attend this meeting.

San Francisco Electrical Development and Jovian League.

A pleasing innovation was introduced by Chairman Alvord at the March 22nd luncheon in the form of a mutual introduction plan prior to turning the meeting over to A. E. Drendell, chairman of the day. Mr. Drendell had provided attractive vocal talent in the person of Miss Addie Johnson, who sang sweetly until the introduction of the speaker of the day, Guy L. Bayley, chief electric and mechanical engineer for the Panama-Pacific International Exposition. In an easy, off-hand, Mr. Bayley told of progress and experience in dismantling the exposition. He stated that the salvage of electrical materials represented close to half the cash value of all material yet sold. He also cited a number of interesting and amusing incidents which arose in the course of the exposition period. Just before giving a vote of thanks to the speaker a drawing for a door prize was held, Mr. C. E. Heise being the winner of a new hat.

Los Angeles Jovian Electric League.

S. H. Head, district manager of the Krogh Pump Company, was chairman of the day at the March 22nd meeting. After President Holland had disposed of business matters, the "cares that infest the day" were disseminated by enchanting music and sweet songs. T. Harvey Dukelow, claim agent of the Southern California Edison Company, speaker of the day, gave a half-hour talk on the workman's compensation and insurance law, which became effective in this state January 1, 1914. The theme of his address was "Safe and Sound," and as claim agent of a large corporation, he spoke authoritatively and with practical knowledge of and familiarity with the subject in hand. He spoke of the attitude of the employer towards the law, which he considers is based on sound and sensible principles, and told what the employer is doing along the line of "Safety First," as follows:

"The human element is difficult to analyze and control. There will always be unavoidable accidents and casualties that result from the violation of the law of safety—this by the employer as well as the employee. Determined efforts should be made, and are being made, to reduce the number of accidents to the minimum. When we come to consider the inculcation of habits of caution as a means of accident prevention, we reach the most difficult and at the same time the most important part of the problem. Safeguards, sanitation, safety lectures, etc., can accomplish much, but any accident-prevention movement must fail largely of its purpose, unless the co-operation of the workmen, themselves, is secured.

pose, unless the co-operation of the workmen, themselves, is secured.

"The companies are now fully awake to the significance of education as a prevention of accidents. Technical skill is desirable, but so, also is education that will develop mental alertness, accuracy of judgment and a genuine and lively interest in the company. Education is imperative for bringing the workmen to a clearer appreciation of life and its responsibilities, and making him more alert to the opportunities and dangers of his profession. But the man who has been at a trade for years is set in his ways and intolerant of change, and unfortunately, this has its bearing on others. Thus, we turn more to the younger man—the new hand at the business—and endeavor to produce workmen who not only will tolerate safeguards and use them, but who from force of habit, will be addicted to safe habits of working.

"Machinery of today exacts from the workman his continual attention, as well as keen and sure ability. This calls into play all his faculties, and it is necessary that he should enter upon the work with a clear mind, and a mastery of himself that he can never have, if addicted to the use of strong liquors, or laboring under some mental strain—quite frequently domestic trouble.

"This brings me to what I believe to be the point of departure in education—the foreman. By friendly personal contact, the foreman is in a position to know the mental and physical condition of the men under him, and in handling such a dangerous agency as electricity, it is obvious that a change of employee is essential where an employee handling dangerous work—is laboring under such great difficulties.

"The employer of today is providing sanitation and education, and this from a humanitarian as well as an economical viewpoint, in the hope that some time, somehow, a careless act will be averted with the result that the employee involved may go home to his family "safe and sound" on the pay-day following."

His talk received loud applause and was enjoyed by all present. Announcement was made that President Henry F. Holland had been appointed honorary member of the Los Angeles Realty Board, after which the meeting adjourned. Ross B. Mateer, commercial agent for the Southern Sierras Power Company, at Riverside, California, will have charge of the April 5th meeting, and is planning some big things. It is expected that a large delegation of visitors from Riverside will be present.

CELEBRATION BY NEVADA ENGINEERING STUDENTS.

The annual engineers' day celebration at the University of Nevada on March 20th was featured by a spectacular parade through the streets of Reno and brought to a close by a unique dance in the university gymnasium. Students from several engineering colleges had prepared typical exhibits in the gymnasium. The electrical engineers ran a generator, operated wireless telephone and telegraph instruments and made demonstrations of high potential electricity. Through the courtesy of the Reno Power, Light & Water Co., several unique lighting effects were obtained. Several moon-light dances transformed the gym into a veritable fairyland, with a moon in the shape of a monster flood-light, filtering down through the canopied roof. This light was one of several used at the Panama-Pacific exposition. In a darkened booth just off the main dance floor, Prof. Hartman presided over a demonstration of high potential discharges through various gases. The beautiful colors resulting and the startling effects obtained, aided greatly in the general enjoyment. An electric waterfall, operated by centrifugal pumps and showing varicolored lights, was another feature in connection with a surveyors' camp established by the civil engineers. The miners operated a miniature crushing and concentrating plant. The mechanical engineers exhibited a model steam locomotive.

TRADE NOTES.

The Hall-Scott Motor Company of Oakland, Cal., have increased their output from four to six motors each week, or a motor a day.

The Mohrlite Company, manufacturers of indirect lighting fixtures, have moved from 247 Minna street to 641 Mission street, San Francisco.

The Wagner Electric Manufacturing Company have started construction on two new buildings to augment their present factory group on Plymouth avenue, St. Louis.

The Bradshaw Electric Sign Company of Oakland, Cal., reports orders from Tait, Madera, Bakersfield, Oxford, Santa Maria, Santa Clara and Martinez. These signs were all of steel with flash electric effects.

The San Francisco Commercial Club will celebrate "Ten Years After" in a great gathering at the Exposition Auditorium, April 18, 1916. This will celebrate the upbuilding of the city during the past ten years.

The Hawaiian Electric Company, Ltd., have recently placed a very large order for equipment for a large substation which they have found necessary to erect to supply the growing demand for electricity on the island.

The Great Western Power Company recently gave a contract to the Associated Engineering & Supply Company of San Francisco for six automatic master oil controllers, an automatic device for eliminating unnecessary losses in burning fuel oil.

Westinghouse Electric & Manufacturing Company, Portland, have orders for supplying Crown-Willamette Paper Company, Oregon City, with an 1800 h.p. synchronous motor for driving four 4-pocket grinders; two 22,000 k.v.a. 60,000-volt transformers, and a 9-panel switchboard, for the new paper mills under construction there.

Oakland Milling Company, Oakland, Cal., will erect an electrically driven rice mill, elevator and warehouse on Oakland Estuary, near Park street bridge, Oakland. C. F. Adams and D. J. Hayes are acting as engineers. The mill will have a capacity of 3000 sacks of rice of 100 lb. per day and will be equipped to make cattle food, bran and hulled material as well as rice flour, etc.

The S. & N. Electric Company, formed in the early part of 1915 for the purpose of transforming gas, gasoline and blueflame stoves to electric has changed its name to the N. & N. Electric Company, with headquarters at the Electric Shop, 237 Powell street and 1612 Haight street, San Francisco, Cal. T. H. Nelmes, president of the company, states that they will also manufacture a projector for the lighting of pictures which does away with the defacing reflector or hood, and which lights the picture and frame only.

Mr. Arthur Simon, of the engineering department of The Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., gave a lecture on magnetic solenoid apparatus before the Engineering Society of Milwaukee, February 16th. During his discussion he showed numerous charts, giving characteristics of solenoids of various kinds, a. c. and d. c. The effect of "coneing and plunger" was also discussed, as well as other peculiarities in design and construction. To further illustrate the lecture, Mr. Simon had a number of the Cutler-Hammer solenoid brakes, contractor type switches and a C-H magnetic gear shift. This device is the apparatus which this company is now furnishing for use on automobile gasoline motor cars and which makes it possible to shift gears from a push button station located just at the fingers' tips below the steering wheel. In the design of this apparatus it was shown how the initial pull brought about by the solenoid method is strong and then as the stroke is about completed how the pull is shaded off. Mr. Simon also showed how the amount of current required for this device is now only a fraction of what was required with early types of this device. This is due to the proper designing of the solenoids

and the working parts at the present time. The amount of current to operate this device is less than for a single blast of the electric horn. The starting and lighting systems of the standard motor car can, of course, be used with this gear shift. The lecture was concluded by showing a 1000 foot "movie" reel featuring two of the Cutler-Hammer high duty lifting magnets at work in the plant of the Inland Steel Company, Indiana Harbor, Ind. The handling of the huge masses of scrap, pig iron and other material, as well as the lifting and dropping of the 20,000 pound skull cracker ball proved to make a very animated and interesting "movie."

NEW CATALOGUES.

Electrical Theatrical Devices of all kinds are illustrated and described in Bulletin No. 49200 from the Sprague Electric Works of the General Electric Company.

Catalogue 28 from Thomas Day Company, San Francisco, is a handsome volume, 10 by 14 in., illustrating their latest designs in electric lighting fixtures. It gives dimensions and prices of fixtures and also shows glassware.

Mica Insulator Company of New York City have issued descriptive bulletins on "Conducell," a method of insulating cable joints in underground transmission systems and "Condu-line," a compound for filling the joints of cables.

Incandescent Supply Company of San Francisco have issued a large catalogue of the complete line carried in local stock. This includes not only various electrical specialties but an illustrated description of gas and electric fixtures, including globes and reflectors.

Bulletin No. 46023, recently issued by the General Electric Company, describes briefly that company's arc circuit volt meter, a special instrument designed for testing direct current series arc circuits. The approximate dimensions and the connections together with prices are included.

NEWS OF ARIZONA CORPORATION COMMISSION.

Arizona, California & Nevada Telephone Company has been authorized by the commission to purchase the telephone lines and exchanges in Mohave county owned by Dan Angius, for \$2000.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Fresno Interurban Railway Company has applied to the commission for authority to issue \$150,000 of bonds, and \$60,000 of stock, to cover cost of construction of its main line to the Centerville Citrus District, and to issue \$150,000 of certificates of indebtedness at 6 per cent for not over 15 years.

The Western States Gas & Electric Company has applied to the commission a supplemental application for approval of expenditures of \$9,714.47 for additions and betterments to plant.

The commission has issued an order authorizing the Valley Telephone Company, operating in Imperial county, to issue 206 shares of stock of the par value of \$100 each, a promissory note for \$1500 at ten per cent to renew a similar note, and another promissory note for \$1000 at ten per cent to renew a note.

NEWS OF IDAHO PUBLIC SERVICE COMMISSION.

Upon the complaint of the Village of Roberts, Jefferson county, that the Ashton and St. Anthony Power Company was not prepared to comply with the provisions of its certificate of public convenience and necessity as regards Roberts until 1917, the commission has ordered that the certificate be set aside only in so far as it affects the Village of Roberts and vicinity. The Utah Power & Light Company, as an intervenor, has been given permission to extend its transmission lines and construct such distribution systems as necessary to serve the district. A further hearing as regards the ability of the Ashton & St. Anthony Power Company to serve irriga-

tion consumers in the vicinity of Mud Lake will be held August 1, 1916. About 5000 acres of land in the vicinity of Roberts require irrigation for successful farming, while about 80,000 acres are without water near Mud Lake, including the irrigation projects of the Owsley-Carey Land & Irrigation Company, Mud Lake Canal Company, North Lake Land Company and Crystal Lake Irrigated Lands Company. The Ashton & St. Anthony Power Company is building a dam and power house on the North Fork of the Snake River, two miles from Ashton and fifty miles northeast of Mud Lake. The plant will have a capacity of 5000 h.p. and cost about \$325,000. The Utah Power & Light Company is already serving Menan, seven miles west of Roberts.

BOOKS REVIEWED.

"Electric Railway Engineering," by C. F. Harding and D. E. Ewing; 409 pp.; 6x9 in. Published by McGraw-Hill Book Co., New York, and for sale by Technical Book Shop, San Francisco. Price \$3.00.

This is the second edition of a text which has already proven valuable in the study of the engineering and economic problems encountered in electric traction. It has been completely rewritten in accordance with the dictates of recent practice. The book is divided into four parts, treating respectively of the principles of train operation, power generation and distribution, equipment and types of systems. While written primarily for engineering students, it will be found useful by all practicing electric railway engineers.

"Coal and Coke," by F. H. Wagner; 429 pp.; 6x9 in.; illustrated. Published by McGraw-Hill Book Co., and for sale by Technical Book Shop, San Francisco. Price, \$4.00.

Information on the carbonization of coal incident to the manufacture of coal gas is herein concisely and logically presented. After treating of the origin and classification of coal, due consideration is given to the theory and practice of its oxidation and spontaneous combustion. Then is considered the distillation of coal, its analysis and its preparation and storage. Succeeding chapters are concerned with carbonization in retort benches, combustion and heating of settings, flue gases, thermic reactions, carbonization in ovens, low temperature carbonization from production with waste heat and the characteristics of coke. The historical method is followed throughout, with special attention to recent methods.

"Central Station Management," by H. C. Cushing, Jr., and Newton Harrison, 397 pp., 5 by 7½ in. Published by D. Van Nostrand Company, New York, and for sale by Technical Book Shop, San Francisco. Price \$2.00.

Examination of this text would seem to indicate that the subject of rates is the point about which the entire central station business operates. In fact "electric rates and costs" might well be the title of the book, as fifteen of the thirty-two chapters are devoted to the subject. Other topics discussed in detail are methods of getting new business, illumination and boiler management. The discussions are mostly "editorial" in character and present a general survey of central station problems aside from those of public policy. It would be an excellent text to place in the hands of every public service commissioner or other person having to do with rate regulation. It also brings into compact form many diverse subjects of plant management. The addition of an index would greatly facilitate the use of the material here compiled.

"Pole and Tower Lines," for Electric Power Transmission. By R. D. Coombs; 272 pp.; 6x9 in. Published by McGraw-Hill Book Co., and for sale by Technical Book Shop, San Francisco. Price \$2.50.

This text comes within the category of engineering literature defined by Prof. Fish as dealing with engineering economics, or, more specifically, economic selection. The author is confessedly a civil engineer, incidentally a most capable one, and apparently somewhat jealous of the tendency of electrical engineers to determine structural details. The

book deals, not with "purely electrical problems, such as the relation of voltage and size of the wires to the electrical characteristics of a line," but the application of the laws of mechanics to line construction. After a preliminary discussion of various types of construction, detailed consideration is given to general design with particular reference to wooden, steel and concrete poles and towers. Foundations, protective coatings, line material and protection are the subjects of separate chapters. The treatment of erection methods and costs is rather limited, but sixteen pages being devoted specifically to the subject. The last chapter contains general specifications for lines, crossings and galvanizing. The subject is handled from the standpoint of a broad survey, rather than specific cases and is concerned with principles rather than applications. An excellent basis for comparison and choice of various types is afforded by the author's well-substantiated opinions. The book covers a field about which there has been a dearth of published information and deserves a place in the library of any engineer engaged in the construction of transmission and distribution lines.

PUBLICATIONS RECEIVED.

Bulletin 86, U. S. Bureau of Mines, "Some Engineering Problems of the Panama Canal in Their Relation to Geology and Topography," by Donald F. M. Donald.

O. G. Aichel, civil engineer at Portland, Ore., through Spon & Chamberlain of New York, has published a pamphlet on "The Caisson as a New Element in Concrete Dam Construction," a proposal made in connection with the Columbia River Power Project.

"High Vacuum, Hot Cathode Apparatus," by August Hund; Vol. X, No. 6, Bulletin University of Southern California, Los Angeles, a brief technical description of the kenotron and pleioton and their application in electrical engineering.

The U. S. Bureau of Standards has just issued a number of new publications as follows: Circular No. 16, The Testing of Hydrometers; Circular No. 57, U. S. Standard Tables for Petroleum Oils; Scientific Paper No. 262, Present Status of the Determination of the Constant of Total Radiation From a Black Body, by W. W. Coblenz; Scientific Paper No. 266, Preparation of Pure Iron and Iron-Carbon Alloys, by J. R. Cain, E. Schramm, H. E. Cleaves; Scientific Paper No. 267, Calorimetric Determination of Acetylene and its Application to the Determination of Water, by E. R. Weaver; Technologic Paper No. 54, Special Studies in Electrolysis Mitigation; III—A Report on Conditions in Springfield, Ohio, with Insulated Feeder System Installed, by Burton McCollum, Geo. H. Ahlborn; Technologic Paper No. 55, Special Studies in Electrolysis Mitigation; IV—A Preliminary Report on Electrolysis Mitigation in Elyria, Ohio, with Recommendations for Mitigation, by Burton McCollum, K. H. Logan; Technologic Paper No. 60, Microstructural Changes Accompanying the Annealing of Cast Bronze, by Henry S. Rawdon; Technologic Paper No. 64, Determination of Barium Carbonate and Barium Sulphate in Vulcanized Rubber Goods, by John B. Tuttle; Technologic Paper No. 65, Determination of Oil and Resin in Varnish, by E. W. Boughton; Technologic Paper No. 66, Detection of Resin in Drier, by E. W. Boughton; Technologic Paper No. 67, Some Qualitative Tests for Gum Arabic and Its Quantitative Determination, by C. E. Waters, J. B. Tuttle; Technologic Paper No. 69, Determination of Carbon in Steels and Irons by Direct Combustion in Oxygen at High Temperatures, by J. R. Cain, H. E. Cleaves; Bulletin No. 3, Calculation of the Maximum Force Between Two Coaxial Circular Currents, by Frederick W. Grover; Construction of Primary Mercurial Resistance Standards, by F. A. Wolff, M. P. Shoemaker, C. A. Briggs; Note on the Resistance of Radio-telegraphic Antennas, by L. W. Austin; A Method of Measuring Earth Resistivity, by Frank Wenner; A New Relation Derived from Planck's Law, by Paul D. Foote.



NEWS NOTES



ILLUMINATION.

SPOKANE, WASH.—Plans are completed for the ornamental lighting system for Sprague avenue, Bernard to Madison streets, to cost \$48,000.

PHOENIX, ARIZ.—The work of installing ornamental electric lighting standards on West Washington street is to be carried on at the same time as the paving is being done.

RIVERSIDE, CAL.—The contract of Fred Schupbach for the installation of single light concrete posts on Robusta street has been accepted. Posts will be furnished and installed for \$11 each.

VENTURA, CAL.—The first decisive step toward municipal ownership of the electric lighting system has been taken by the city trustees. A committee has been appointed and given power to secure plans and specifications for an electric plant.

HILO, HAWAII.—Work will be started shortly on the construction of a Hilo gas plant, if the plans of E. J. Smith, former superintendent of the Hawaii Telephone Company do not miscarry. The gas company will operate under the John T. Baker franchise.

SAN GABRIEL, CAL.—Application has been made to the board of trustees for a 40 year franchise granting right to lay a system of gas pipes for carrying gas in this city. Sealed bids will be received at the office of the city clerk for such a franchise up to May 9th.

SANTA BARBARA, CAL.—Ornamental concrete lighting standards, instead of the present metal ones for State street, from Arlington to the beach, and the placing of the present standards on Carrillo and Figueroa streets is under consideration by the city council.

LOS ANGELES, CAL.—An ordinance declaring the intention of the city council to order the necessary cast iron lighting posts and appliances to be installed and maintained for a period of one year for the lighting of Wilshire boulevard and Park View street, has been passed.

FLORENCE, ARIZ.—Bonds in the amount of \$50,000 have been voted for a new municipal waterworks and electric lighting plant by the citizens of Florence. The town will buy electric power from the state, and a transmission station will be installed in connection with the new water plant.

SEATTLE, WASH.—Plans have been outlined by the city light department for the construction of an addition to the Lake Union auxiliary steam power plant to cost about \$250,000. The additional unit will have a capacity of 13,000 horsepower and will be located north of the present building. Plans for the structure will be prepared by City Architect Daniel Huntington, while the machinery plans will be under the supervision of Superintendent of Light and Power J. D. Ross.

SALT LAKE CITY, UTAH.—Secretary of State David Mattson has proposed to the Utah state capitol commission that this magnificent new building be illuminated by means of flood lighting system at the time of its dedication and thereafter. W. D'A. Ryan has examined the building and pronounced it particularly well adapted to the installation of a flood lighting system. The commission is favorably impressed with the suggestion made by Mr. Mattson regarding it as a much more modern and more effective way of illuminating a building than with the old system of lights on the building itself. In addition it is proposed to install a thoroughly modern system of lighting for the capitol grounds.

TRANSMISSION.

LOS ANGELES, CAL.—Actual construction of the municipal power distributing system in Highland Park, Garvanza

and East Los Angeles district will begin immediately, it has been announced.

SAN BERNARDINO, CAL.—It is probable that the Santa Fe railroad will erect a private power plant in the local yards to supply power for its properties here. A private water system is also considered.

LOS ANGELES, CAL.—A permit has been issued for the erection by the water department of a municipal power plant at St. John and Holly streets. The building will be a three-story concrete structure to cost about \$60,000.

MULLAN, IDAHO.—J. L. Martin, president and general manager of the Carney Copper Company, states that the company is negotiating for electric power and a compressor which is to be installed as soon as the snow will permit.

LOS ANGELES, CAL.—Acting Mayor Betkouski has issued a public statement in which he asserts that the council does not intend to ask another bond issue as rumored to complete the municipal power project, as the money is now in the treasury to do all the work promised.

PORTLAND, ORE.—The elimination of all overhead electric light and telephone wires in the central East Side is to be proposed by City Commissioner Daly. He has asked City Attorney La Roche to prepare an ordinance requiring the replacement of the present overhead system with underground lines.

MOGOLLON, N. M.—The installation of a power plant on the mesa is engaging the attention of the management of various companies operating in Mogollon. The construction of power houses, removal and re-installing of machinery, and construction of power lines will require less than a month to place all in commission for resumption of mining and milling.

TURLOCK, CAL.—Engineer Meikle has submitted a preliminary estimate of the cost of producing power in the Turlock Irrigation District for drainage purposes, as follows: 4 units of 400 h.p. each; foundations, structures, \$40,000; turbines, generators, complete, \$36,000; transformers, \$6000; transmission line, 40 miles \$40,000; installation of 50 pumps \$25,000; contingencies, \$22,000. Total \$169,000.

KELSO, WASH.—The North Coast Power Company, with offices in the Pittock block, Portland, is constructing a seven-mile transmission line from Kelso westerly to serve Diking District No. 1, in which a pumping plant of 150 h.p. is being installed. By this extension two other diking districts on the delta between the Columbia and Cowlitz rivers are to be supplied with power for pumping water. Surveys for the two new districts have been made by F. M. Lane, engineer, Kalama.

SALT LAKE CITY, UTAH.—Application has been filed for 10 cubic feet of water per second from the North and South branches of the North Fork Creek in Utah county for power purposes by John R. Stewart of Provo, Utah. The application sets forth that a dam and pipe line and water power plant will be installed for the purpose of supplying electricity and for lighting and power purposes in Utah and Wasatch county. The water, after being used will be returned to the Provo river.

SALT LAKE CITY, UTAH.—The Utah Power & Light Company, through their tax agent, C. M. Brown, has submitted to the Utah State Board of Equalization schedule of its taxable property in the state, together with a statement this company owns properties to the value of \$5,472,890 in the state of Utah and in addition has leased from the Utah Light & Traction Company property with a total value of \$3,424,-

055. This company has the largest valuation of any public utility company in the state.

PHOENIX, ARIZ.—F. A. Ward, acting superintendent of the Gila River Indian Reservation, has been conferring with the state board of control relative to conditions under which a right of way would be furnished across the reservation for the proposed power line to Florence and Florence state prison. The legislature has made an appropriation of \$19,400 for the construction of this line to connect the power plant and line of the reclamation service and water users. The power will be utilized for pumping and to supply lights. It is probable that work will begin at an early date.

TELEPHONE AND TELEGRAPH.

YUMA, ARIZ.—W. N. Bunton, manager of the local telephone exchange, is considering establishing an exchange at Somerton.

TUCSON, ARIZ.—Immediately upon the completion of the new telephone exchange building being built by the Mountain State Telephone Company the work of installing entirely new and modern equipment will begin.

GARFIELD, WASH.—The trustees of the local telephone system have two offers from telephone men to buy the local plant and install a new system. J. H. Horton, E. J. Byrne and S. A. Manning will canvass the stockholders in regard to the proposition.

PASCO, WASH.—The Pacific States Telephone & Telegraph Company has bought out the Twin City Telephone Company of this city, and will soon take charge of the local exchange. The Twin City Telephone Company has been operating in this valley for about ten years. The long distance exchange which was recently moved from this city to Kennewick for the local business of the Columbia Valley, will be returned to Pasco, where a large, modern structure awaits the new company.

RICHMOND, CAL.—A surprise was sprung at a recent meeting of the city council when two bids for a contract for a telephone franchise for 49 years came up. The Pacific States Telephone & Telegraph Company, which had applied for the franchise, sent in a bid of \$100 for the contract. G. L. Fitz, representing Wm. O. Scott of San Francisco, offered \$200. The Pacific company countered with a bid of \$225 and was awarded the franchise. The city will receive 2 per cent of the company's earnings, estimated at \$125,000 per annum.

TRANSPORTATION.

EUGENE, ORE.—Extension of the Oregon Electric Railway from Eugene to Springfield, a distance of about four miles, is a possibility of the coming summer.

ALBUQUERQUE, N. M.—A definite movement has been made for the extension of street car service on North Fourth street to serve the district within the city limits and extending to the U. S. Indian School.

MEDFORD, ORE.—President S. S. Bullis of the Southern Oregon Traction Company has submitted a proposition to the people of Medford, involving the extension of the company's electric line 10 miles to the Blue Ridge mine. The county will give all possible assistance and there will be no trouble securing franchises.

PENDLETON, ORE.—An electric road from Pendleton to Walla Walla and from Cold Springs Landing through Pendleton to Bingham Springs is an undertaking projected by an association of capitalists represented by C. W. Lefler, formerly a farmer in the Cold Springs country. It is understood E. W. McComas of Pendleton is connected with the undertaking.

REDLANDS, CAL.—The railroad committee of the chamber of commerce has been directed to negotiate with the president of the Pacific Electric Railway in regard to extending the P. E. system to the Yucaipa valley. It was stated

that the request for a main line extension of the Southern Pacific through Redlands has been referred to the general manager of the road.

FRESNO, CAL.—The directors of the Fresno, Hanford and Summit Lake interurban Railway Company met recently and formally went out of existence. Between 4000 and 5000 railroad ties, the only assets of the company, were turned over to Charles S. Lee, the secretary, who served for five years without compensation. It was decided at the meeting to return all of the deeds in this and Kings counties that were received gratuitously and to attempt to secure financial returns on the rights way which were purchased when the plan was started to construct an electric road out of Fresno. The directors present at the meeting were: W. M. Giffen, W. D. Mitchell, A. V. Taylor, W. J. Kittrell, C. R. Cutten, F. J. Haber and H. P. Brown. Nearly all of the stock is now in the hands of Brown, who besides being financially interested in the road, has acted in the capacity of attorney.

WATERWORKS.

OATMAN, ARIZ.—The board of supervisors has granted a franchise to the Oatman Water Company.

RENTON, WASH.—The city council will probably engage an engineer to make an investigation of the water plant here with a view to enlarging it.

CANBY, ORE.—The city council has fixed May 19th as the date on which to vote on the bond issue of \$18,000 which is required to secure a first-class water system.

CALEXICO, CAL.—The board of trustees will receive sealed bids up to April 4th for furnishing pipe and valves for the construction of extensions to the local water system.

GOLDENDALE, WASH.—The application of John Thams to construct and maintain pipe lines across and along streets in the town of Bingen in Klickitat county has been approved.

ROSEBURG, ORE.—A petition has been presented to the Roseburg city council asking that a committee be appointed to investigate the feasibility of constructing a municipal water system.

LAS VEGAS, N. M.—J. H. Dockweiler, San Francisco engineer, has undertaken the designing and construction of an irrigation project in San Miguel county near Las Vegas. The work will begin within two months and be completed within a year, at a cost of approximately half a million dollars.

RUPERT, IDAHO.—An ordinance has been passed by the village of Minidoka providing for the issuance and sale of \$6000 in bonds to provide for the construction of a municipal waterworks plant. The bonds will be issued in denominations of \$500 each, payable January 1, 1916, and redeemable January 1, 1926.

HAMILTON, MONT.—City Clerk Reese has about completed a census of Hamilton and a survey of the water plant. From the data collected a report will be compiled for the city council. The council now has under consideration estimates prepared by a Seattle engineer at a cost of \$500. Some are in favor of the installation of a new gravity system drawing the water from Blodgett Creek. This plant it is estimated will cost about \$93,000.

PORTLAND, ORE.—R. W. Rea, hydraulic engineer, with offices at 412 Spalding building, has been appointed to the position of project engineer of the Ochoco Irrigation District. This project has recently been organized as an irrigation district under the laws of the state of Oregon, and a complete engineering investigation and estimate of cost will be made at once. Field surveys will commence about April 1. This project was the subject of a preliminary report by a joint government and state survey in 1914-15, in which the total cost was estimated at about \$800,000. The construction work, including an earth-fill dam and reservoir, will store about 40,000 acre feet of the waters of Ochoco Creek.

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JOURNAL OF ELECTRICITY

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PER COPY, 25 CENTS

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BY JOHN H. LEWIS.

ELECTRIC COOKING IN A CAFETERIA.

BY B. C. HANNON.

FEASIBILITY OF WESTERN ELECTRO- METALLURGY.

BY DORSEY A. LYON AND ROBERT M. KEENEY.

STANDARD ACCOUNTING METHODS.

BY EDWARD N. HURLEY.

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MR. ENGINEER, during this season of stress, don't repair with ordinary wooden material, but standardize on a "STEEL" line and arm every pole for its yearly conflict.

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UTILIZATION OF OREGON'S LATENT WATERPOWERS

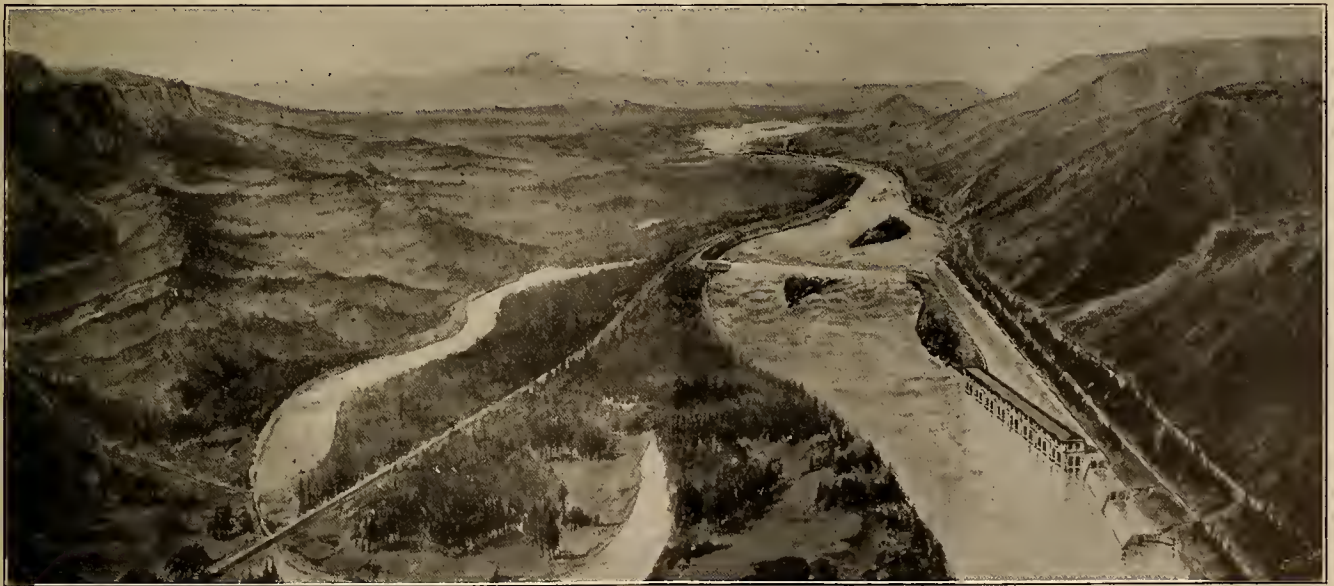
BY JOHN H. LEWIS.

(This article is adapted from a bulletin "Oregon's Opportunity in Industrial Preparedness," prepared by the author as state engineer of Oregon, giving tentative plans and estimates of costs of hydro-electric projects capable of developing over 2,000,000 h. p. for electro-chemical and irrigation purposes and incidentally improving the navigability of the streams.—The Editor.)

For years we have talked in generalities of the great water power possibilities of Oregon and the Columbia River basin. Little thought has been given to the study of any particular project, or how the power of that project could be utilized.

The most logical project to suggest for early construction is at Bonneville, on the Columbia River. Because of its proximity to Portland, the metropolis

projects have been here in large numbers; they have carefully surveyed the field for their respective industries; they have prepared elaborate prospectuses and presented them with all possible forcefulness to local and eastern capitalists; they have persisted for a few months or sometimes years and have then disappeared from our midst poorer but wiser men, their projects undeveloped and their money spent.



Top—Proposed Power Project at the Cascades of the Columbia River. Bottom—Proposed Dam, Powerhouse and Locks at Bonneville—Cascade Locks in the Distance.

of Oregon, its location at the head of tide water, and its effect on navigation of the Columbia River as far as The Dalles, where over 1,000,000 electrical horsepower can be had in projects of various sizes, and the necessity for overcoming the swift water between Bonneville and Cascade Locks before the upper power could be utilized in manufacturing products for world markets, it was thought fitting to study this project in some detail.

Much of Oregon's energy has long been devoted to an effort to promote development of agriculture and industries within the state. Promoters of industrial

There are good reasons why Oregon has not been able to secure enough industrial development to be worth the mention. Local capitalists have largely accumulated their fortunes through the advance in real estate values and their lack of experience in development or industrial matters makes them timid in financing such enterprises. Often the promoter has not had the mental capacity, business connections, experience and capital to properly present his enterprise to eastern or foreign capitalists; but more often the industries have not been well suited to this locality for lack of raw material or nearby market.

The promotion has been based upon the availability of cheap power, but the vivid picture of the millions of horsepower in "white coal" going to waste in the West has not seemed to impress the cold, calculating financier now engaged in manufacturing in the East. The reason is that, except in a very few industries, the cost of power is not the controlling and not often even an important part of the cost of production.

What should be done? The question is easily answered but not easily executed. We must seek those industries to which the cost of power is the controlling cost or a very important part of the cost of production and whose market is a world market. To secure them we must not only show that we have cheap power, but we must show that it is cheaper than at Niagara Falls and elsewhere. If we cannot show this to be true under existing conditions, then we must so legislate by subsidizing, guaranteeing bond interest, or even, if necessary, by actual public development of power as to make our power compete with other districts by virtue of the cheap interest rates thus made feasible. Public opinion is slow to change. To overcome the fear that private capital is seeking to gobble up and monopolize the water powers of the Northwest, and swing to the other extreme of encouraging development, through perhaps some form of a subsidy, will take time. There may be some grounds for such fear of monopoly in the East. But it will be centuries before any material part of the water power in the Northwest is used, unless we can compete with the world in attracting those comparatively new electro-chemical and electric furnace industries, which use power in wholesale quantities.

By cheap power we mean \$8 to \$12 per horsepower year delivered in large quantities to industries in the vicinity of the power plant.

When it is remembered that the item of interest is one of the largest when figuring the annual cost of power produced from falling water, the importance of providing for public development can be appreciated. If a market for much of this power can be found, were the annual price per horsepower reduced below what private capital could afford to furnish the same, then it is the duty of the public, with its superior credit to finance the enterprise, just as we are now building a railroad in Alaska to make available for use the extensive coal deposits heretofore inaccessible. We will thus have a split enterprise; the public building and operating the water power plant at a profit, to enable private capital to build and operate various technical enterprises for the utilization of this power at a profit.

We should also assist financially in the experiments necessary to develop and perfect certain chemical manufacturing processes which are now largely experimental but which if technically successful on a large scale give promise of commercial adaptability to local conditions.

Recently a new angle has developed in the power market by virtue of the agitation for "preparedness" for national defense in case of war. The first requirement of preparedness is to be able to make our own explosives, and these require nitrogen compounds

almost entirely imported from abroad. In case of war our supply could be easily cut off by a greater sea power and we would be left to our own resources. These nitrogen compounds are made in the electric furnace in Norway, Sweden and to some extent in Canada, while Germany and Austria are depending entirely upon electric made nitrogen for explosives used in the present war. These countries have experimented for years to develop and perfect their processes and have enormous sums invested in the necessary works. They have many men trained to operate these furnaces skillfully, and who are able to instruct others when the need arises for increasing the output for war purposes.

The electricity for making nitrate is nearly always generated by water power. This gives the West a chance to acquire a proportion of this development, for we have more abundant water power than elsewhere. To do so will require adequate broad-minded and constructive legislation, neither that advocated by the conservationist or the exploiter.

In order to secure our share of this prospective development we must be prepared to discuss intelligently the water power resources which we have available and to present their merits at the proper time. We must also be considering the proper legislation to meet the new situation, as well as to meet the fertilizer trade of this and foreign countries which must be developed in conjunction. Nitrates serve for fertilizers in time of peace and explosives in time of war.

One of the uses to which this water power can be put is in pumping water to arid lands. Three hundred eighty thousand horsepower will be required to irrigate 558,000 acres of land lying along the Columbia and Snake Rivers, within a radius of 70 miles from the proposed Umatilla Rapids power project. The average pumping lifts range from 225 to 380 ft. While these lifts are higher than would probably be justified using electric current at prevailing commercial rates, yet with power furnished by the public, say at cost, from projects constructed partly in aid of navigation, they may ultimately be found to be feasible.

The detailed information in the following table was taken from the report of Joseph Jacobs, prepared in connection with the Columbia River power project near The Dalles. The variation in cost per horsepower per irrigation season is due to the fact that transmission costs from The Dalles project are included. With short transmission lines from projects in the vicinity of the land, the cost of power might still further be reduced under favorable conditions. At best, irrigation development through pumping will increase but slowly. Therefore, until such time as some method is found whereby long time payments and low interest rates can be had for the construction of both the power and irrigation projects, it is doubtful if an irrigation loan would prove attractive in financing a large water power development.

One of the most promising markets for our wasting water power resources is in the establishment of the mixed fertilizer industry, and in the making of nitrates for explosives used in munitions of war. The essential conditions for the establishment of such industries are cheap water power, necessary raw re-

Area Susceptible to Irrigation by Pumping in Vicinity of Umatilla Rapids Project.

Location.	Irrigable Acres.	Water Duty Pumpage—Inches.	Average Pumpage—Head in Ft.	Required Pumping Capacity—Sec. Ft.	Approx. Cost of Completed Project—Per Acre.	Annual Cost of Maintenance and Depreciation—Per Acre.		Price of Power per H.P. per Irr. Season Based on Transmission from The Dalles.	Approximate Motor Capacity—H.P.
						A	B		
Horse Heaven Slope.....	61,000	38.75	300	593	\$61.00	\$6.66	\$13.43	\$9.90	33,400
Berrian Slope of Columbia River....	4,300	37.50	367	41	63.00	7.70	14.50	9.80	2,800
Castle Rock, Arlington Slope.....	150,000	48.50	380	1,820	65.00	10.10	17.21	10.08	130,700
Three Rivers Slope.....	42,000	41.25	343	435	58.00	8.63	14.98	10.85	28,500
Pasco	80,000	41.25	265	833	50.00	6.59	12.92	10.38	41,700
Benton	109,000	50.00	225	1,438	48.00	7.30	12.60	10.83	61,200
Priest Rapids.....	112,000	46.25	316	1,369	49.00	9.38	14.02	11.09	82,000
Total	553,300	.....	...	.....	\$59.00	.....	.....	.....	380,300

A—Annual cost exclusive of interest, depreciation and taxes, it being not unusual to charge interest and taxes against the land value which is ordinarily assessed to include the value of the irrigation works and to meet depreciation by special assessment when renewals are required.

B—Annual cost, including interest at 6 per cent, taxes at 1 per cent, and depreciation at varying rates, on total cost of irrigation works. From report by Joseph Jacobs in connection with report on Columbia River power project.

sources, and convenient rail and water transportation to the markets of the world.

The market for such products, which can be made largely in the electric furnace, is almost unlimited, if we can successfully compete with other countries. Ordinarily about \$500,000,000 worth of fertilizer is consumed annually by the nations of the world. In 1913, when conditions were normal, about \$125,280,000 worth of commercial fertilizer was used in the United States. Of this amount, the farmers paid \$48,830,000 for nitrogenous substances, \$56,000,000 for phosphates, and \$20,450,000 for potash salts. Practically all the potash salts were imported from Germany, and the entire quantity of nitrate of soda came from Chile, while some electrically made nitrate of lime was imported from Norway. Phosphates were obtained largely in Florida and other Southern States.

All of these ingredients necessary for the mixed fertilizer industry are found in the Northwest.

Potash can be had from the giant kelp, which grows in beds along the Oregon and Washington coasts. Experts tell us this can be recovered in competition with Germany under ordinary conditions. At the present time, potash is selling at eight to twelve times its normal value. Though a bill authorizing the leasing of kelp beds along the Oregon coast was introduced in the last legislature, no action was taken. At present it is therefore impossible to secure sufficient title to warrant the investment of capital in works for the recovery of potash.

Nitrates can be had from the air through the fixation of atmospheric nitrogen in the electric furnace. It is said that there is enough nitrogen in the air over one square mile of the earth's surface to supply the world for 50 years.

Phosphates can be had from the rich mineral deposits of Idaho and Montana. These deposits are now withdrawn from entry pending legislation by Congress. In 1914, 2,734,000 tons of phosphate rock were produced in the Southern States, about one-half of which was exported to Europe. Not one ton was produced in the Northwest.

In case of war, the United States would be at the mercy of the enemy, if communication with Chile should be shut off. All of our nitrates for explosives now come from this foreign country. During 1912, the world paid Chile \$30,000,000 as export duties on nitrates, and we are in this way contributing largely

to the support of a foreign government. To build the necessary hydroelectric plants and works to supply our own nitrate needs in case of war would take several years.

One of the first steps in connection with the present program for preparedness should be the building of one or more plants for the manufacture of nitrates in the United States. Such a plant should not be located on the international boundary, as at Niagara Falls, or too near the seacoast to be defended. It should be built by or under the control of the government. At least, one of these plants should be located in the Northwest.

A logical location for such a plant would be at the Cascades of the Columbia River, near Bonneville. At this point, 200,000 continuous electrical horsepower, with an equal amount of secondary, or part time power, can be generated through the construction of a dam to raise the water 44 ft. at low stage. The investment of a relatively small amount of money in test pits and borings to determine foundation conditions and in preliminary designs and estimates would determine the feasibility of this project from an engineering standpoint and its approximate cost.

The federal government could well afford to build this dam in the interest of navigation. If it did not see fit to go into a complicated technical industry, it could install the necessary electrical equipment and lease the power at prices which would induce the construction by private capital for the production of nitrates and commercial fertilizers. In time of war, the production of fertilizers could be discontinued, and all energy generated used in the production of nitrates for explosives.

Government Aid Necessary.

Private capital in the United States is not educated as yet to invest in these complicated technical industries. It is said by those who have studied the situation from a world standpoint that before the war certain French bankers would advance money for nitrate plants in Norway upon a margin of 8 per cent anticipated profits, but that American bankers required a showing of 20 per cent anticipated profits.

The reason for this is that enormous investments of capital must be made in a field comparatively new and untried for our American financiers. The subsequent invention of a new process might immediately

jeopardize such investment. New inventions are constantly being made to perfect present commercial processes, and until such time as capital can be shown that these industries are upon a stable technical footing it will be difficult to secure American capital for such enterprises.

Just as the government assisted in the construction of pioneer railroads, so it appears necessary for the federal government to pioneer to some extent this new field in order to demonstrate the feasibility of these industries technically and commercially.

By selling the power to some industries below cost, to others above cost, according as they are able to pay, it is believed that all the power from the first plant could be disposed of and many new industries started which otherwise could not get a foothold. By having access to the figures of actual cost through public control of the power, it could soon be determined whether or not it would be necessary for the government to continue in this field. It might develop that the profits were so great and permanent that private capital could be found to build not only the technical works, but also the future dams, power houses and locks, thus furnishing improved navigation facilities without cost to the public.

Because of our enormous undeveloped resources, our favorable climate, convenient rail and water transportation, and the possibilities for development through the establishment of a world commerce in fertilizer, it appears that every thinking person in the Columbia River basin should unite in some practical program which will result in making available accurate and reliable information, based on the actual operations of a chemical plant on a commercial scale.

Sweden contributed largely toward the construction of a demonstration electrical iron and steel plant operated by the iron and steel makers' association of that country. The figures as to cost for this experimental plant have been made available to the world. As a result, the electrical iron and steel industry has been established in Sweden, thus saving the iron industry, which was rapidly dwindling in importance, due to the increasing cost of charcoal for the old process.

Besides the fertilizer and nitrate industries, which, from our limited information, appear most promising at the present time, there are many other new industries wherein cheap electrical power is an important factor in the selection of a location. Our own demands for iron and steel may ultimately be met through the importation of ore from China, Mexico and other countries, utilizing the electric furnace for smelting. Enormous electric smelters may ultimately be established to handle the copper, zinc, and other ores, which may be brought as return cargoes. As our population increases, a considerable amount of power will ultimately be disposed of in electric cooking, in electric operation of farm machinery and to some extent for heating of houses; for the operation of pulp and paper mills, woolen mills, furniture factories and other industries with which we are now familiar, as well as in connection with the operation of transcontinental and suburban railroads.

The population of Oregon and the Columbia River

basin is small, and the existing markets for hydro-electric power are already oversupplied.

It is stated that "power companies supplying Portland have in operation steam and water power plants that can supply 30,000 horsepower in excess of the present demands of the market." In addition to this, existing companies have water rights initiated for undeveloped power far in excess of this developed power.

The present markets will increase but slowly as population increases, and the present plants are not adequate for chemical manufacturing purposes. Unless we are fortunate enough to secure some of the new industries mentioned above, which use hydro-electric power in large quantities, there is little likelihood that any material part of the water power in the Columbia River basin will be put to use during the life of the present generation. This power must be utilized, if at all, in the manufacture of products which can be shipped to all parts of the world.

Unless these markets materialize the oversupply of this resource may ultimately be found to be a curse; our rivers cannot be tamed. They will continue to flow on to the ocean, a menace to any life and property which ventures to surmount the various rapids. Navigation for only high power boats will be of but little advantage in furnishing cheap transportation to the farmers of the great inland empire. Our arid lands will continue to thirst for the life giving waters, which in some districts can only be supplied by pumps utilizing cheap power. And our much heralded birth-right will prove but a mess of pottage.

Summary of Projects Discussed.

	Minimum Primary Capacity Continuous E. H. P.
Columbia River:	
Cascade Project.....	200,000
The Dalles Project.....	480,000
Umatilla Rapids	120,000
Deschutes River:	
Deschutes River System.....	504,000
Metolius River	98,000
Snake River:	
Palouse Rapids	50,000
Asotin	54,000
Coon Hollow	200,000
Cherry Creek	200,000
Mountain Sheep	120,000
Salmon River Tunnel Project.....	200,000
Addition to Mountain Sheep Project if Salmon River Project is developed.....	80,000
Rogue River:	
Devil's Stair	12,000
Horseshoe Bend	13,000
Klamath River	70,000
Total continuous E. H. P.....	2,401,000

To facilitate reference, a brief summary of the important features in connection with each of the above mentioned projects will here be given:

Columbia River Projects.

Cascade-Columbia Project:

Location—143 miles above the mouth, 42 miles above Portland. This project has a very strategic location at the head of tidewater and of ocean navigation and near the commercial metropolis of Portland. It would also eliminate a very serious and the only obstacle to barge navigation of the Columbia to The Dalles and would open the river to this point for ocean commerce.

River Discharge—50,000 second-feet, minimum.
Head—44 feet.
Power—200,000 continuous electrical horsepower.
90,000 E. H. P. surplus for 11 months.
120,000 E. H. P. surplus for 10 months.
220,000 E. H. P. surplus for 8 months.

420,000 E. H. P., total possible capacity available for 8 months or more.

Capital Cost—Exclusive of dam, about \$11,000,000; insufficient data available for estimate of dam.

The Dalles-Columbia Project:

Location—4 miles above The Dalles; 190 miles from the mouth of the river.

River Discharge—50,000 second-feet, minimum.

Head—105 feet at 50,000 second-feet, decreasing to 45 feet in limiting flood.

Power—480,000 primary continuous E. H. P.
120,000 surplus continuous E. H. P. for 11 months.
100,000 surplus continuous E. H. P. for 10 months.
100,000 surplus continuous E. H. P. for 8 months.

800,000 total continuous E. H. P. available 8 months or more.

Capital Cost—\$50,000,000.

Projects on the Deschutes and Metolius Rivers.

The Deschutes River and its principal tributary, the Metolius River, offer many sites for power development, some of which are remarkably cheap in first cost. There are no large concentrated falls, all developments either contemplating a dam for the full height of the head developed and enough more to reach good foundation, or in one or two cases a low dam and diversion canal with flume or tunnel for recovery of the remaining head. Nevertheless some of the projects are very low in first cost. All estimates have been based upon gravity concrete dams, the estimates of the first two projects including \$10 per electric horsepower for lands and right of way, and the remaining projects \$5 per electric horsepower for this purpose.

Summary of Deschutes and Metolius River Power Projects.

Powersite.	Miles from Columbia River.	Head.	Flow—Sec. Ft.	Horsepower.	Total Cost, Including Right of way.	Cost per Horsepower.
Deschutes R. Sites:						
Moody	3	132	4,500	54,000	\$4,560,000	\$ 84.45
Lockit	14	70	4,500	28,630	1,901,000	66.41
Reclamation ..	20	92	4,500	37,600	2,328,000	61.91
Sinamox	29	87	4,500	35,600	1,778,000	49.94
Oak Brook	37	65	4,500	26,500	1,610,000	60.75
Sherar Falls ..	44	100	4,500	40,900	3,742,000	91.30
Oak Springs ..	49	32	3,700	10,820	1,254,000	115.87
Maupin	53	132	3,700	44,500	4,472,500	100.65
Freida	63	140	3,700	47,360	4,716,800	99.59
White Horse Rapids	77	138	3,700	47,200	3,039,000	64.38
Coleman	89	58	3,700	19,680	1,840,400	93.00
Mecca	98	90	3,400	27,760	1,878,800	67.68
Pelton	107	60	3,400	18,560	1,052,800	56.72
Metolius	111	210	3,400	64,960	3,954,800	60.88
Metolius R. Sites:						
Riggs	135	1,400	17,200	1,626,000	94.53	
Whitewater ..	260	1,200	28,360	2,115,800	74.69	
Jefferson Crk ..	400	1,000	36,360	2,751,800	75.67	
Jack's Creek ..	300	600	16,360	2,781,800	170.00	

Total horsepower, Deschutes River sites, 504,070.

Total horsepower, Metolius River sites, 98,280.

Umatilla Rapids Project.

Location—3 miles above Umatilla, and 290 miles above mouth of Columbia River.

River Discharge—40,000 second-feet, minimum.

Head—35 feet.

Power—120,000 E. H. P., continuous.
320,000 E. H. P. for irrigation season.

Capital Cost—\$20,500,000 for 320,00 E. H. P.

Snake River Projects.

The proposed Snake River projects in general involve the construction of dams to the full height of the head to be utilized and enough more for foundation purposes.

The Snake River canyon is generally narrow and steep and is cut into a basaltic lava formation. Two lower projects in Washington are discussed chiefly because of their relation to improving navigation to the larger sites above, and because of the possibility of selling sufficient power for irrigation or other purposes to finance the improvement of navigation.

Palouse Rapids Site:

Location—7 miles below Riparia, Wash.

River Discharge—12,000 second-feet, minimum.

17,000 second-feet with storage.

Head—32 feet.

Power—50,000 E. H. P. (greater than minimum because irrigation load comes during high water.)

Capital Cost—\$4,500,000 or \$90 per E. H. P.

Asotin Project:

Location—Above Asotin, Wash.

River Discharge—10,000 second-feet, present minimum.
15,000 second-feet with storage.

Head—60 feet.

Power—54,000 E. H. P., minimum.

80,000 E. H. P., with storage.

Capital Cost—\$5,400,000 or \$100 per E.H.P. for 54,000 E.H.P.
\$6,600,000 or \$82.50 per E.H.P. for 80,000 E.H.P.

Coon Hollow Project:

Location—On Snake River, 45 miles above Lewiston, Idaho, and 5 miles south of the northeast corner of Oregon.

River Discharge—10,000 second-feet, minimum.
15,000 second-feet for an average of 11 months per year.

Head—200 to 220 feet.

Power—200,000 E. H. P., continuous.

300,000 E. H. P., for 11 months.

300,000 E. H. P., continuous with possible use of existing storage.

Dam—Gravity concrete.

Capital Cost—\$15,200,000 for 200,000 E. H. P. development or \$76.00 per E. H. P.

Annual Cost of Generation—\$5.90 with 80 per cent of power sold.

Cherry Creek Project:

Location—On Snake River, 51 miles above Lewiston, Idaho, and below the mouth of Salmon River.

River Discharge—Same as Coon Hollow.

Head—200 feet.

Power—200,000 E. H. P., minimum.

300,000 E. H. P., with storage.

Capital Cost—\$13,600,000 for 200,000 E.H.P. or \$68 per E.H.P.
\$18,100,000 for 300,000 E. H. P. or \$60.35 per E. H. P.

Mountain Sheep Project:

Location—On Snake River, 55 miles above Lewiston, Idaho, and 3 miles above the mouth of the Salmon River.

River Discharge—6,000 second-feet, minimum.

10,000 second-feet, with addition of Salmon River through diversion tunnel or by storage as for Coon Hollow project.

15,000 second-feet, minimum with both Salmon River and storage water.

Head—200 to 220 feet.

Power—120,000 continuous electrical horsepower.

200,000 continuous electrical horsepower with either storage or Salmon River diversion.

300,000 E. H. P., with both additional sources.

Dam—Concrete arch.

Capital Cost—\$14,000,000 for 200,000 E.H.P. or \$70 per E.H.P.

\$16,400,000 for 300,000 E. H. P. or \$54.70 per E. H. P., assuming Salmon River project to have been developed without cost to this project.

Salmon River Tunnel Project:

Location—30 miles southwest of Grangeville, Idaho, a railroad terminus, 80 miles above Lewiston, Idaho.

Works—Diversion dam 150 feet high on Salmon River near Freedom, Idaho; water carried by canal and 7-mile tunnel through mountain to power house on Snake River.

River Discharge—4,000 second-feet, usual minimum.

Head—505 feet to 530 feet, net.

Power—200,000 E. H. P., continuous.

100,000 E. H. P., additional, April to October.

Capital Cost—\$19,215,000 or \$96.08 per E. H. P. for 200,000 E. H. P.
\$25,320,000 or \$84.40 per E. H. P. for 300,000 E. H. P.

Rogue River Developments.**Devil's Stair Damsite:**

Location—About 3 miles west of east line of Curry county and about 35 miles northwest of Grants Pass.

River Flow—1,350 second-feet, minimum.

Head—100 feet.

Power—12,000 E. H. P., continuous.

30,000 E. H. P., peak at 40 per cent load factor.

Capital Cost—\$2,100,000 or \$70 per E.H.P. for 30,000 E.H.P.

Horseshoe Bend Damsite:

Location—On Rogue River, about 5 miles east of west line of Josephine county.

River Discharge—Same as for Devil's Stair Site.

Head—110 feet.

Power—13,100 E. H. P., continuous.

30,000 E. H. P., at 43 per cent load factor.

Capital Cost—\$1,700,000 for 13,100 E.H.P. or \$130 per E.H.P.

\$2,100,000 for 30,000 E.H.P. or \$70 per E.H.P.

Klamath River Power Project.

Location—About 25 miles southwest of Klamath Falls.

Works—2½ miles of tunnel and 8 miles of concrete lined canal.

River Discharge—1,160 second-feet.

Head—700 feet net.

Power—70,000 E. H. P.

Capital Cost—\$6,400,000 or \$91.50 per E. H. P.

This will conflict with a large proposed irrigation project in California. Part of the water supply will be stored in Klamath Lake, which is navigable and under federal control. Here, again, we are confronted by interstate and federal questions, just as for the water power projects on the Columbia and Snake Rivers.

ELECTRIC COOKING IN A CAFETERIA.

BY B. E. HANNON.

(Details are here given of the electric equipment of a successful cafeteria where all cooking is done electrically. This desirable load for a power company was obtained in competition with gas at \$1.00 per 1000 cu. ft. and with distillate, the chief factor in the decision, being a saving of \$90 per month in lessened shrinkage of meat. The author is manager of the Sacramento district of the Great Western Power Co.—The Editor.)

The Quaker cafeteria at Sacramento, California, occupies a one-story building, 80 ft. by 80 ft., built especially for it. It is provided with a sprinkling system on the roof for cooling in the summer, besides having a rather elaborate heating and ventilating system. The dining room is 60 ft. by 80 ft. and has a seating capacity of 250. The interior is all done in white with blue trimmings. One of the novelties in the furnishings is the expensive Brussels carpet which covers the entire dining room, instead of the usual tile floor.

The serving counter, which extends along the rear wall, is 45 ft. by 27 in. The steam table, 16 ft. long, is in the middle of this counter and contains: 7 entree pans (12 in. by 15 in.), roasting pan (16 in. by 16 in.), 6 vegetable pans (12 in.), 6 gravy and soup bowls (8 in.), 3 hot bread pans (23 in. by 13 in.). This steam table which is lagged with two-inch magnesium block, contains 180 gallons of water which is maintained at a temperature of 212 deg. by six Simplex circulating water heaters with a total capacity of 8.75 kilowatts. These heaters are at present operated continuously but there is to be a time switch provided to keep them off the peak load.

For breakfast the following portable equipment is used on the counter: 1 egg boiler, 1 egg poacher, 1 toaster, 1 18 by 18 grid for frying bacon and eggs,

1 18 by 18 grid for hot cakes, 2 4 in. Simplex waffle irons.

One of the features of the serving counter is the butter refrigerator. This refrigerator contains twenty tin trays on which are placed twenty butter pans, making a total of four hundred servings of butter. These pans are taken from the refrigerator and placed on the counter as needed, in that way doing away with the usual bowl of ice.

The equipment in the kitchen consists of:

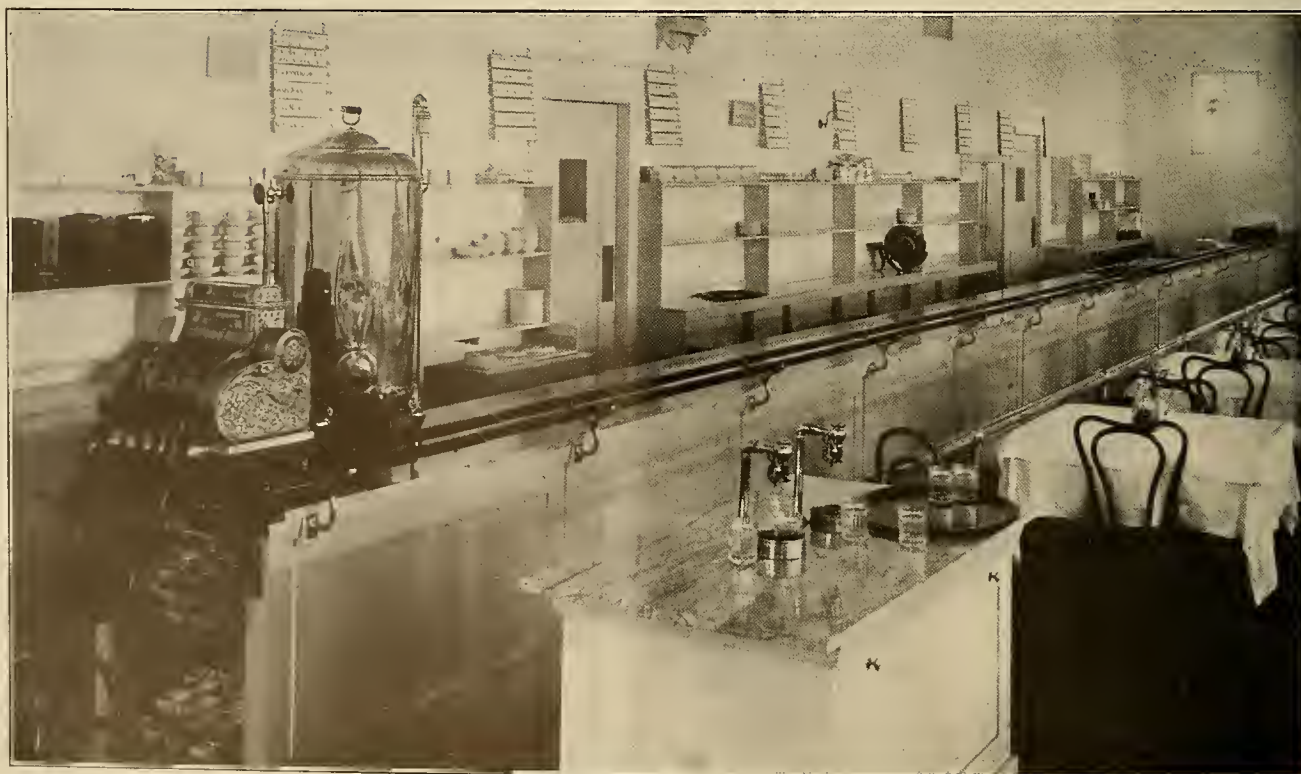
One No. 215 Hughes bake oven used exclusively for pastries handles the following material per week: 500 pies, 60 3-layer cakes, 105 pans (23 by 13) hot bread (40 orders each), 15 pans short cake, 45 loaves nut bread (2 lb.) 250 cup custards, 600 baked apples, 250 apple dumplings, 35 puddings.

The baker also has a No. 24 Hughes range for heating milk and making frostings, and a Simplex 12 in. fry kettle for frying doughnuts.

A No. 175 Hughes bake oven is used for meats and turns out the following per week: 280 lb. rib roast, 60 lb. lamb, 40 lb. pork, 210 lb. stew, 100 lb. hash, 50 lb. bacon, 30 lb. ham, 50 lb. hamburger, 15 lb. meat loaf, 90 lb. turkey, 75 lb. chicken, 50 lb. duck, 450 lb. fish, 800 lb. roast potatoes, 100 lb. beans, 100 lb. macaroni.

A 16 hole Hughes range (15 ft. by 3½ ft.), having six 12 in. 4. kw. open-type elements, six 9 in. 2000 watt, four 9 in. 1500 watt elements, and four 18 by 18, three-heat grids, used for frying and keeping the food warm after it is taken out of the oven.

On account of the great weight of the kettles and pans the severe usage to which the range is subjected, we found it necessary to cover these elements with cast iron grids. These grids are slotted to obtain both radiated and conducted heat.



Electrically Heated Steam Table.



Electrically Equipped Kitchen.

The warming closet for the dishes is 4 ft. by 2 ft. by 5½ ft., and is heated by two 1100 watt, three-heat, units.

There is an automatic dish washer operated by a ½ h.p. motor for the china dishes. Besides this there are three ordinary dish tubs for the pots and pans. They use approximately 1500 gallons of hot water at 160 deg. temperature per twenty-four hours.

The potato peeler and food chopper are both operated by 1 h.p. motors.

The two-ton refrigerating machine is driven by a 3 h.p. motor.

The total equipment consists of:

Range	53.0 kw.
Pastry oven	10.5 kw.
Meat oven	6.5 kw.
Small pastry range.....	5.0 kw.
Fry kettle	2.0 kw.
2 waffle irons.....	2.0 kw.
Toaster	3.5 kw.
Egg boiler	2.5 kw.
Egg poacher	2.0 kw.
2 griddles	7.0 kw.
Warming oven	2.2 kw.
<hr/>	
Water heaters on steam table.....	96.2 kw.
Motors	8.75 kw.
Sign and outside lights.....	4.5 kw.
Inside lights	2.5 kw.
	4.0 kw.

19.75 kw. 115.95 kw.

All cooking equipment is metered with a maximum demand meter and separate meters are provided for motors (3-phase), inside lights, sign and outside lights. The water heater operates on a flat rate.

The maximum demand of the cooking equipment is about 55 kw. with a load factor of 30, based on 730

hours per month. The revenue from the cooking equipment is about \$190.00 per month. The total revenue, including motors, steam table and lights, is about \$300.00 per month.

Kilowatt hours per meal, .623; No. meals served per month, 20,000. Total cost per meal, \$.0121.

The following help is employed: 1 cashier, 1 checker, 1 floor girl, 4 buss boys, 1 linen checker, 1 supply boy, 8 girls behind steam table, 2 cooks, 1 baker, 1 salad maker, 7 helpers in the kitchen, 1 porter and night watchman.

Besides Messrs. Swannell and Parker, president and secretary of the Cafeteria Company, respectively, there is one man in charge of the dining room and one in charge of the store room.

There was a fire-proof vault built in the basement of the building in which two 50 k.v.a. transformers were installed in order that the voltage drop be as small as possible.

As the result of the successful operation of this cafeteria the Great Western Power Company has already sold a 550 loaf (62 kw.) bake oven to the largest bakery in town and if it proves satisfactory, will sell two more of the same size. All of the bakers in the city are watching the ovens with a great deal of interest and we feel sure that this bake oven load will soon be one of our greatest revenue producers.

A merger of the Southern California Edison Company and the Pacific Light & Power Corporation is reported to have occurred at Los Angeles.

FEASIBILITY OF WESTERN ELECTRO-METALLURGY.

BY DORSEY A. LYON AND ROBERT M. KEENEY.

Present Commercial Status of Electro-metallurgy.

(Continued.)

Ferro-alloys. The growth of the ferro-alloy industry in Europe has been rapid since 1899, but comparatively slow in the United States. There are about 25 plants engaged in the manufacture of ferro-alloys by the electric furnace method as compared with two plants making the alloys in the electric furnace in the United States. There is, however, an electric furnace ferrosilicon plant in Canada at Welland, Ontario.

There are several reasons why the growth of this industry has been more slow in America than in Europe. Hydroelectric power is not as cheap here and not so favorably located, for the receipt of raw material and the sale of product. The water power sites can not be developed so cheaply as many of the foreign sites where the cost of electric power per horse power year varies from \$7 to \$15 as compared with \$15 to \$30 in the United States. This refers to power delivered at the manufacturing plant transformers. In Canada power is somewhat cheaper, but is often located in inaccessible places. Most of the Norwegian and Swedish plants are located on tide-water or navigable rivers. French works are within a couple of hundred miles of Marseilles. The use of ferro-alloys in the manufacture of high class steels did not advance as rapidly in the United States as in Europe, and owing to less favorable natural advantages, electrochemical and electrometallurgical industries in general have not had so rapid progress and growth.

A large proportion of the ferro-alloys used in the United States are imported, as, although there is a duty, local manufacturers do not supply the whole demand. About one-half of the ferromanganese and one-half of the ferrosilicon used in the United States are imported, as well as a large part of the ferrotungsten. More ferrotitanium and ferrovanadium are manufactured here than abroad. The ferrochrome production just about supplies the local demand.

In Europe the industry of manufacture of ferro-alloys in the electric furnace is in excellent condition commercially with the demand for alloys steadily increasing. Because of the large navies built by European countries, there has been a great demand for ferrochrome. The sale of ferro-alloys in Europe, especially ferrosilicon and ferrochrome, is accomplished by the various plants combining in a syndicate with each plant receiving a portion of the total market demand according to arrangement.

In the United States, the Titanium Alloys Manufacturing Company has a plant for the production of ferrotitanium at Niagara Falls, N. Y. The electro-metallurgical Company has plants at Knawha Falls, West Virginia, and another at Niagara Falls, N. Y. This company makes ferrosilicon, ferrochrome, ferrotungsten, ferrovanadium, ferromolybdenum and ferrophosphorus. The Primos Chemical Company, Primos, Pa., manufactures metals and ferro-alloys by chemical methods or in combustion furnaces. Among its products are ferro-tungsten, ferrovanadium, tungsten metal, ferromolybdenum, ferrochrome, ferronickel and ferroboren. The American Vanadium Company

manufactures ferrovanadium by a method similar to the thermit process at Bridgewater, Pa. The Goldschmidt Thermit Company has a plant for the manufacture of metals and ferro-alloys by the thermit process at Newark, N. Y., but imports most of its products from its foreign works. This company produces ferrotitanium, ferrovanadium, ferromolybdenum, ferrosilicon, ferrochrome and chromium as well as other metals and alloys. It has been recently reported that the Noble Electric Steel Company was about to begin the manufacture of ferro-manganese at its electric furnace plant at Heroult, California, and possibly ferrochrome.

Imports of ferro-alloys into the United States during the year ending June 30, 1913, were as given in the table below. The rates of duty were those in force previous to the passage of the present tariff. Under the present tariff all duties were reduced considerably, in most cases being made 15 per cent ad valorem. Hence it may be reasonably expected that imports will increase if the steel business is good at some time in the future.

	Rate of Duty. per ton.	Quantity. tons.	Value. Value.	per Unit.
Ferromanganese	\$2.50	\$128,136.55	\$5,484,829	\$42.80
Ferrosilicon (over 15 per cent silicon)	20%	9,257.18	574,494	62.06
Chromium and ferrochrome, value \$200 per ton or less	25%	459.09	53,624	116.80
Value more than \$200, per ton	20%	68.29	35,667	563.55
Ferrophosphorus, value \$200 per ton or less	25%	81.38	3,689	45.33
Molybdenum and ferromo- lybdenum, value more than \$200 per ton	20%	7.00	15,939	3187.80
Titanium and Ferrotita- nium, value \$200 per ton or less	25%	7.00	305	43.71
Value more than \$200 per ton	20%	19.21	9,213	479.59
Tungsten and ferrotung- sten, value more than \$200 per ton	20%	654.30	795,467	1215.75

Pig Iron. The introduction of the electric furnace for smelting iron ore is of advantage only in localities where charcoal and coke are expensive and electric power cheap. The electric furnace consumes one-third of the carbon used by the blast furnace in the manufacture of pig iron, and hence its use may be advantageous where coking coal is scarce and charcoal expensive. In considering electric smelting of iron ores with regard to its commercial status at the present time, it must be remembered that the electric furnace is in this case competing directly with the blast furnace product regardless of its location due to the cheapness of water haulage. It is not like the aluminum or ferro-alloy industry, where the electric furnace has the field to itself, because of its technical and commercial superiority over any combustion process. Hence, in proportion to the amount of pig iron produced, we can not expect to show nearly as large a rate of increase for the electric furnace process as in the case of aluminum and ferro-alloys.

That the electric furnace has been successful in the smelting of iron ore in those districts which are favorable to the same is shown by the fact that ten furnaces of the Trollhattan type and one of the Helfenstein type with a total power capacity of about 40,000 h.p. are in operation in Sweden. In this country there is one electric furnace pig iron plant of two

furnaces with a total capacity of about 7000 h.p. in operation at Heroult, California. As previously stated, the California furnaces are of the rectangular type. While electric smelting of iron ore has been technically successful at Heroult, it does not appear to have been as successful commercially as in Sweden due to the cost of reducing material, i.e., both charcoal and coke. Although the electric furnace uses only one-third of the coke or charcoal that the blast furnace uses, on the Pacific Coast of the United States all solid reducing agents are so scarce and expensive that it appears to be the great problem of electric smelting as well as of blast furnace smelting of iron ores. Attempts have been made to use oil, but these have not yet proven very successful.

While advances in electric smelting of iron ore have been satisfactory considering that its field of use is limited, the actual tonnage capacity of electric pig iron furnaces is small. This is quite clear when it is remembered that the total erected capacity in power consumption of electric iron smelting furnaces, 47,000 h.p., would produce about the same amount of pig iron per day as one modern blast furnace of 450 tons output per 24 hours.

Steel. In 1904 there were four electric furnaces being used in Europe for the manufacture of steel, whereas today there are 114 electric furnaces producing steel in Europe and the United States and 30 others are in course of construction. As in other electrothermic processes, development has not been so rapid in the United States as in Europe. Only 14 furnaces are in use in this country. The average capacity per charge of the furnaces already built is 3.7 tons, whereas that of the furnaces under construction is 4.5 tons, an increase of 21.6 per cent. The total charge capacity of the furnaces now installed is about 250 tons per charge, and the total charge capacity of the furnaces under construction will be 170 tons per charge. The arc furnaces vary in capacity, from 1 to 15 tons and require from 200 to 1500 kw. for operation. A Heroult furnace of 25 ton capacity, requiring 3000 kw., is nearly completed at Bruckhausen, Germany. The induction furnaces vary in capacity from 1 to 10 tons and require from 165 to 600 kw. for operation.

Of the 114 furnaces in operation 84 are arc furnaces and 30 are induction furnaces, of the 30 under

construction 26 are arc furnaces and 4 induction furnaces.

The accompanying table gives the annual production of steel in electric furnaces by countries for the years 1908 to the first half of 1912.

From Table 1 it may be seen that for a new process in so conservative an industry as iron and steel manufacture progress has been very rapid since 1903. Germany leads all countries in the steady growth of the process and the total tonnage produced. Although in Germany the production of electric-furnace steel increased 67.8 per cent in 1911, in the United States it decreased 44.2 per cent. The decrease in this country was probably due to the conservatism of American steel makers, which has prevented the wide adoption of the process before experimental results have conclusively proved its merits. From present indications there will be a considerable increase in the production of electric-furnace steel in this country in the near future, although a very small tonnage, 6882 tons, was reported by the American Iron and Steel Institute as the output for the first half of 1912. Of the total production of electric-furnace steel in the United States in 1911, 27,227 tons were ingots and 1878 tons castings. Of the total tonnage of electric-furnace steel made here in 1911, 6700 tons were alloy steel and 462 tons were rolled into rails. The large production of steel in the United States and Germany in proportion to the number of furnaces operating is due to the use of molten Bessemer and open hearth steel instead of cold scrap. The use of the latter almost entirely accounts for the comparatively small tonnage produced by France in proportion to the number of furnaces in operation. No figures were obtained for England, but it is probable that at least 10,000 tons of electric-furnace steel is manufactured in England. It is estimated that about 12 furnaces operate there, several of which receive hot-metal charges. Italy, Norway, Switzerland, Belgium and Russia produce small tonnages also. The slight increase in the total electric-furnace steel production for 1911 over that produced in 1910 was caused by the big decrease in the United States.

In the first years of its development the electric process was considered as a competitor of the crucible process only for making high class steel from scrap iron and scrap steel; but with the successful

Table 1—Yearly Production of Electric-Furnace Steel.

Country.	1908			1909			1910			1911			1912
	Production—tons.	No. of furnaces..	Change in produc- tion—per cent..	Production—tons.	No. of furnaces..	Change in produc- tion—per cent..	First half—tons..	No. of furnaces..	Change in produc- tion—per cent..	Production—tons.	No. of furnaces..	Change in produc- tion—per cent..	
Germany and Luxemburg.	19,536	8	....	17,773	8	—9.0	36,188	13	+104.1	60,654	15	+67.8	....
United States	55	1	....	13,762	4	....	52,141	7	+228.0	29,105	9	—44.2	6,882
Austria-Hungary	4,333	..	....	9,048	..	+109.2	20,028	..	+120.8	22,867	10	+14.0	....
France	2,686	7	....	6,515	12	+127.6	13,445	21	—106.2	13,850	21	+ 3.0	7,920
Sweden .....	....	..	....	591	11	....	431	12	— 27.0	2,034	13	+72.0	....
Norway .....	....	..	....	....	..	....	....	1	....	....	1	....	....
England .....	....	..	....	....	..	....	....	..	....	....	12	....	....
Italy .....	....	..	....	....	5	....	....	2	....	....	4	....	....
Switzerland .....	....	..	....	....	..	....	....	..	....	....	2	....	....
Belgium .....	....	..	....	....	..	....	....	..	....	....	2	....	....
Russia .....	....	..	....	....	..	....	....	..	....	....	1	....	....
Total	26,610	16	....	47,039	40	+ 78.2	120,116	56	+155.4	126,476	90	5,22	....

operation of larger furnaces the electric process is likely to become an important adjunct to the Bessemer and open-hearth processes as a means of super-refining the molten products that they yield. The electric process, however, does not appear to be destined to supersede either of these methods, as greater efficiency and economy are obtained by a combination of any two of the three processes as a duplex process. The success of recent experiments has obtained for the electric process a definite place as a super-refining method. In time preliminary refining will probably be done mainly in the Bessemer converter, the process being finished in the electric furnace or the open hearth. In Europe the electric-furnace process for making steel of the highest grades is rapidly superseding the old crucible method, because of its greater economy of operation and the possibility of using materials of lower grade.

Copper. So far as we are aware, no copper ores are being treated at the present time in the electric furnace in this country. It is reported, however, that in Norway trial smeltings of copper ores with an electric furnace of 1000 horsepower and an estimated producing capacity of 2000 tons per annum have been conducted at the Ilen Smelting Works, Trondhjen, and we understand that it is the intention to smelt copper ores regularly at this plant in the electric furnace.

More or less experimental work has been done upon the subject, and, as a result of this work and reasoning by analogy, there seems no good reason why copper-bearing ores cannot be as successfully treated in an electric furnace as in a combustion furnace. In all furnaces of the latter class which are used for this treatment of copper ores the fuel used takes no part in the reactions which are necessary for obtaining the desired product, unless it be in the reduction of oxide ores which are smelted alone, that is, without an admixture of sulphides, which is practically an unheard of thing in this country at the present time. For example, in the reverberatory furnace the fuel acts only as a heating agent; in blast furnace smelting, if what is known as ordinary blast furnace smelting is used, the coke added to the charge is for the purpose of supplying the heat necessary to raise the charge to such a temperature as will permit of the necessary reactions between the oxides, sulphates and sulphides present, and to scorify the resultant mass and thus permit of the separation of the slag and matte. In semi-pyritic and pyritic smelting the necessary oxidation of the sulphides and iron is brought about by the oxygen of the air entering the tuyeres, and the coke used is simply for the purpose of supplying the amount of heat necessary for the successful carrying out of the process, which is not supplied by the oxidation of the sulphur and the iron present in the charge at the time it passes through the tuyere zone of the furnace. Such being the case, there seems to be no reason why the smelting of copper ores could not be done as well by electric heat as by that derived from the combustion of coke, especially if local conditions warrant it. The writers, as a result of experimental work which they have done in connection with tests which have been made by the U. S. Bureau of Mines, and likewise judging from results which have

been obtained by others, believe that it is perfectly feasible both metallurgically and commercially (the latter, of course, depending upon local condition) to use the electric furnace for the smelting of copper ores.

Zinc. Although, as previously stated, more progress has been made to date in the electric smelting of zinc ores than with the electric smelting of any of the non-ferrous metals except aluminum and metals forming ferro-alloys such as silicon, chromium and tungsten, nevertheless the process is still largely in the experimental stage. There is no plant operating on a commercial scale except the Trollhattan works taking from 10,000 to 13,000 h.p. There are about 24 furnaces installed at this plant, each requiring from 400 to 1200 h.p. The same company, the Norse Power and Smelting Syndicate, also has a smaller plant near Trollhattan at Sarpsborg, where there are seven small furnaces. One other small commercial plant is in course of erection at Keokuk, Iowa, by the Johnson Electric Smelting Company. It appears that the experiments conducted at Hartford, Connecticut, for several years have proven successful enough to warrant the installation of a small commercial unit to test the process further. The Johnson process and the Trollhattan process are essentially the same. Johnson claims to have overcome the problem of condensation of zinc vapor into zinc instead of blue powder.

From the work at Trollhattan and the results of others it is evident that the difficulty in electric smelting of zinc ores almost entirely lies in condensation of zinc vapor to a metal rather than blue powder under the peculiar conditions of the electric furnace. The electric furnace, mechanically or electrically, presents no great difficulties to solve, because all of the troubles formerly experienced have been solved in the construction of large pig iron, steel, carbide and ferro-alloy furnaces. The problem then is one of a metallurgical nature, and is caused by the different conditions and greater speed of smelting in the electric furnace than in the combustion retort.

The solution of this problem is very probable, and, while it is difficult, there is no reason why it should not be worked out in time. When this is solved, and it is not necessary to resmelt a large proportion of blue powder as at Trollhattan, where two tons of blue powder are smelted for each ton of ore treated, it is probable that electric smelting will proceed rapidly in favorable localities. The use of iron as a desulphurizing agent does not seem to have advanced as far as the reduction of oxide with carbon, and it is probable that the latter will keep its present supremacy.

A man's efficiency, as a machine, is about 8 per cent, assuming that the food consumed daily has a calorific value of 4 kw.-hr. Twenty-four men working a treadmill in one-hour relays could drive a 0.2 kw. dynamo capable of supplying eight 25-watt tungsten lamps. If each man were paid a dollar a day their wages would amount to \$5.00 per kw.-hr. of output from the dynamo.

STANDARD ACCOUNTING METHODS.

BY EDWARD N. HURLEY.

(This excerpt from an address on "Trade Associations and Better Business Methods," before the Boston Commercial Club, March 28, 1916, is particularly applicable to the electrical industry. It applies as well to jobbers, contractors and dealers as to manufacturers. The author is vice-chairman of the Federal Trade Commission.—The Editor.)

When business was done on a large percentage of profit, questions of accurate cost and of operating efficiency were not so important, but in most lines of industry today the large percentage of profit has passed. Manufacturers are working on smaller margins and must absolutely know what their goods cost. With margins of profit so close, any unreliable method of arriving at cost of production must be eliminated.

It is a fact well understood among business men that the general demoralization in a large number of industries has been caused by firms who cut prices not knowing what their goods actually cost to manufacture, and the cost of selling, which is equally important, is almost wholly lost sight of. Are the officers of the companies who are cutting prices right and left irrespective of their costs, fair to their customers, stockholders or competitors?

A manufacturer who does not know with a close degree of accuracy what it costs him to produce the different articles he manufactures and what it costs him to sell them, is not in a position to meet intelligently competition and invites business disaster.

The Federal Trade Commission has been in existence one year and after surveying the field we found from preliminary investigation that 200,000 corporations out of a total of 260,000 engaged in the manufacturing and mercantile business of the United States were eking out an existence; 100,000 of them did not earn a penny. Out of 60,000 successful corporations doing a business of \$100,000 a year over 30,000 charged off no depreciation whatever. Only 10 per cent of our manufacturers and merchants know the actual cost to manufacture and sell their products; 40 per cent estimate what their costs are, and 50 per cent have no method but price their goods arbitrarily. Most of the manufacturers and merchants who do not know what their goods cost are basing their selling price on what their competitors sell for and with only this knowledge for a basis they are frequently cutting prices and demoralizing the industry in which they are engaged.

There were over 22,000 business failures in the United States last year; more than 20,000 of them were small concerns. We all know that a large percentage of business is run at loose ends, haphazard and without the proprietors really knowing at any time how they stand or whether they are making a profit or a loss.

Many of the larger manufacturers have thorough cost accounting systems, which they recognize as necessary in order to give them the information essential to successful management. On the other hand, the number of small manufacturers who have no adequate cost accounting system and who price their goods arbitrarily is amazing.

Proper accounting for the smaller manufacturer is most essential. It is necessary for his success that he know on what particular article he is making a fair profit and on what he is making only a narrow margin of profit or losing money. If he has this information he can concentrate on the manufacture and sale of the product on which the profits are satisfactory.

Whole industries, in many instances, are suffering from a general lack of intelligent knowledge of cost.

How can the Federal Trade Commission help to improve this situation?

The commission has no intention and no desire to use compulsory methods. But it does hope to reach the desired end by encouraging improvements in accounting practice, by indorsing standard systems of bookkeeping and cost accounting, and by assisting in devising standard systems, either at the request of individual merchants and manufacturers, or through the association that represents the industry.

The metric system of weights and measures will be used exclusively in the revised edition of the U. S. Pharmacopoeia, the standard reference of the medical and drug profession. As an aid in this transition from the customary system the U. S. Bureau of Standards is preparing a circular on weights and measures for the pharmacist and physician.

An artificial eye has been devised by Ives and Kingsbury in the form of a thermopile whose readings indicate the intensity of luminous radiations with a precision better than one per cent. Non-luminous radiations are screened out. This instrument is capable of measuring color differences as accurately as is done by the methods of visual colored light photometry. This instrument shows that one lumen corresponds to 0.00159 watt of luminous flux.

A co-operative electric range sales campaign has been started by the Puget Sound Traction, Light & Power Company, under the direction of H. J. Gille, sales manager. A stock of each manufacturer's ranges will be carried by a local jobber who will resell to the central station and will otherwise act as the manufacturer's agent. The employment and direction of the salesmen will be done by the central station, as will also be the working out of the sales campaign details. The plan provides for the employment of four salesmen to represent each manufacturer's product exclusively. These men will receive a commission of 10 per cent of the net price on each range sold, and will be guaranteed a minimum of \$75 per month. The deficit, if any, between the monthly commission totals and the seventy-five-dollar minimum is to be divided evenly between the central station and the manufacturer. A certain amount of general advertising will be done by the manufacturer, and the central station will carry on an advertising campaign and will furnish all necessary facilities for suitable demonstrations, etc.

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POWER AND GAS

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION ETC., required by the Act of Congress of August 24, 1912, of "Journal of Electricity, Power and Gas," published weekly at San Francisco, for April 1, 1916.

State of California,

County of San Francisco—ss.

Before me, a Notary Public in and for the state and county aforesaid, personally appeared Edward B. Strong, who, having been duly sworn according to law, deposes and says that he is the business manager of the "Journal of Electricity, Power and Gas," and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Names of	Post Office Address.
Publisher, Technical Publishing Company.....	San Francisco, Cal.
Editor, A. H. Halloran.....	No. 6 Crossley Bldg., San Francisco
Managing Editor, A. H. Halloran.....	No. 6 Crossley Bldg., San Francisco
Business Manager, E. B. Strong.....	No. 6 Crossley Bldg., San Francisco

2. That the owners are:

E. B. Strong.....	San Rafael, Cal.
R. J. Davis.....	Berkeley, Cal.
A. H. Halloran.....	No. 6 Crossley Bldg., San Francisco
C. L. Cory.....	Nevada Bank Bldg., San Francisco
Robert Sibley.....	Berkeley, Cal.
Mrs. L. B. Storey.....	Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

E. B. STRONG, President.

Sworn to and subscribed before me this 31st day of March, 1916.

(Seal)

CHARLES EDELMAN,

(My commission expires April 7, 1918.)

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As a result of the demand for more light, the deficiency has been supplied by increased lamp efficiency and greater sales proficiency. There is now more light everywhere. In some places there is more than enough. For, as regards lights, too much seems as bad as too little.

Better Lighting

This undesirable excess of light is technically known as glare, and is defined as such excessive brightness within the field of view as to cause discomfort, annoyance or interference with vision. So there is now arising a counter-demand for the elimination of glare, with consequent call upon engineering efficiency and sales proficiency to supply the deficiency. Thus is the cycle repeated and so will it be repeated until progress shall be no more.

The first tangible evidence of the campaign to minimize glare has been on the public streets, where the evil was most glaring. This came in response to safety first requirements. Headlights on automobiles and street cars must now be dimmed to make street traffic safe. The latest types of arc lamps for street purposes employ diffusing glassware. There are even a few merchants who realize that glaring store-window lighting destroys confidence. Trade follows light used judiciously, but avoids the dazzling and the blinding. Judging from appearances, moths are the chief buyers of cheap jewelry.

As the undesirable glare of the streets is in process of correction it is high time to conserve vision in the home. The glare of interior lighting, while less intense, is more enduring than the glare of exterior illumination. This subject has recently been studied by the committee of the Illuminating Engineering Society which has arrived at tentative figures indicating safe limits for contrast of brightness within the range of vision.

Suggestions are made for distributing brightness not only from lighting equipment but also from ceilings, walls, paper and desks. It is found that eye fatigue is produced by contrasts in lighting. Consequently it is suggested, as the results of experiments, that the ratio between the brightness of a light and the darkness of a non-luminous surface should not be greater than 100 to 1. Practically speaking this means that dark-colored walls call for less brilliant light sources than white walls, the proper quantity of light being obtained by increasing the number of light sources. These suggestions should be kept in mind when planning the illumination of interiors and should also be applied to those interiors where light causes discomfort to the eye. Thus will we have not only more light but better light.

The most vital task before the electrical men of the West today is that of getting more current-consuming devices on existing lines. The success that has already been achieved in this regard is only indicative of what remains to be done. The greatest obstacle in the way of greater achievement is the ignorance of electrical men themselves about what can be done electrically.

A specific citation is pertinent. The other day a power salesman visited an electric shop in one of the

The Need for Teaching the Dealer

big cities. An electric range was on the floor. The proprietor was asked a few leading questions about the purpose, current consumption and advantages of this device, none of which he could answer. He only knew that the jobber had consigned the range to him for demonstration purposes. He thought that rates were too high in his community to make electric cooking attractive to the housewife. This is a true story, nor is it an isolated instance.

Before starting any campaign to educate the public about the advantages of electric cooking it is first necessary to teach the dealer. The dealer can then teach and encourage the would-be purchasers, instead of discouraging them. An educative campaign among the dealers is a necessary preliminary to any sales effort direct to the consumer.

Lectures, demonstrations and articles in periodicals read by electrical dealers are essential. It is useless to make a sale which is later to be killed by an ignorant dealer. When dealers understand the capabilities of appliances their intelligent co-operation will do more to put electrical devices on lines than any amount of house-to-house canvassing by central station solicitors.

The fault lies not so much with the dealer as with the manufacturer and the central station. They seem to have overlooked the capability of the dealer as a load-builder. In the haste to erect a superstructure the foundation has been neglected. A part of this teaching task has been voluntarily assumed by the jobber. He needs help and co-operation from both the manufacturer and the central station if his educative campaign is to be carried to the final fruition of better business for every branch of the industry.

Now, to be specific, let an active committee on the education of electrical dealers be created by the National Electric Light Association, the Associated Electrical Manufacturers and the Electrical Supply Jobbers' Association. Each association is carrying on more or less educational work among the employees of its members and is talking about educating the consumer, but is neglecting the education of the dealer. The future of the electrical business depends upon the intelligence of the electrical dealer, the merchant who sells to the consumer. Instead of arguing and fighting as to whether appliances be sold by the manufacturers, the jobber or the central station, it behooves all of them to get together to teach the dealer.

In chemistry, a catalytic is an agent that brings about a change in a compound while itself remaining unchanged. Thus cane-sugar and water are changed into glucose by the action of sulphuric acid, which is itself unchanged and ready to perform a similar function indefinitely. The mere presence of such an extra substance accelerates chemical change as may be seen by putting a piece of platinum into a mixture of hydrogen and oxygen to form water, or by adding manganese dioxide to heated potassium chlorate to liberate oxygen. A minute amount of material, which adds little or no energy to the reaction, is thus able to bring about tremendous changes.

Such, modestly speaking, is the function of a tech-

nical paper. It is the agent whereby men's thoughts are brought into contact and allowed to react upon each other. It is a means to the end of hastening industrial advance.

In order to effectively fulfill this contactor function the journal should be freely furnished with the ideas of the men in the industry. They should regard the journal as employed by them to bring about necessary changes in the business, to stimulate reaction and accelerate progress.

No matter what the difficulty,—whether technical in nature and involving unprecedented construction, whether commercial in character and calling for new sales methods, or whether of a sociological kind and tending toward the establishment of better public relations,—it can be best met by an exchange of experiences. Mouth-to-mouth exchange of experience is as limited in scope and inefficient in action as would be dependence upon gold or silver coin as a medium of financial exchange. Just as credit has replaced coin and the clearing-house the individual bank, so the technical journal is available as an active clearing-house of experience.

No editorial staff can be everywhere simultaneously, know everything instinctively and see everything at once. The reader's assistance is needed. The ideal technical journal is one where every reader is a contributor. If every subscriber sent in the news of his job every other subscriber would be benefitted. The perfect journal is one in which a reciprocal relation exists between the subscriber and the paper. In order that a magazine may be the voice of an industry the reader should be the eye and ear.

In this respect, the technical journal is a quasi-public utility. Its private ownership is as incidental to the public service as is the private ownership of an electric power company. Experience has demonstrated that such matters can be more effectively conducted by private initiative supplemented by public participation. There is no other means which so adequately and promptly fulfills the requirements for disseminating information as the technical journal.

The editor's duty is to serve the industry which his paper represents. No matter how strong his imagination and how great his ability in thinking of different ways of helping people, he is in a large measure dependent upon the subscriber's assistance.

So, respected reader, we make an earnest plea for your more active participation in the benefits which this journal is capable of conferring upon you. Have you found a better method of cost accounting? Send it to the editor. Are you using a new kink in construction or operation? Share it with others. Is there some question about which you are in doubt? Ask the opinion of those who have already solved it. Have you done something of which you are proud? Let others know of it. Any article, however brief, is welcome if it helps the reader.

A journal is like an association in that the reader gets out of it directly as he contributes to it. The essence of mutual benefit is in reciprocal use. Use the journal as a relay for your ideas, as a clearing-house for your experiences and as a catalyzer of your thoughts. We are then most truly at and in your service.

PERSONALS

Howard N. Place of the Edison Laboratory, New York, is at San Francisco.

M. Fortini, secretary of the Standard Electric Construction Company, is at Los Angeles.

F. F. Bostwick, president National Safety Appliance Company of San Francisco, is at Oroville, Cal.

Albert Meinema, city sales manager of the Electric Appliance Company at San Francisco, is at Chicago.

J. Q. Brown, general manager of the Nevada Valleys Power Company, spent last week at San Francisco.

N. K. Cooper, sales manager with the Westinghouse Electric & Manufacturing Company, is at Tonopah, Nevada.

A. Emery Wishon, assistant general manager of the San Joaquin Light & Power Company, is at San Francisco.

W. D. Kohlwey of the firm of Kohlwey, Smith & Alfs, recently returned to San Francisco from Los Angeles.

H. P. Pitts, industrial engineer Pacific Gas & Electric Company, is making a trip through the Pacific Northwest.

S. B. Gregory, Pacific Coast manager Arrow Electric Company, is recovering from an attack of tonsillitis at Seattle.

C. R. Hunt of Robbins & Myers, has returned to San Francisco from Seattle, Spokane, Tacoma, Walla Walla and Portland.

D. P. Fullerton, general superintendent of plant of the Pacific Telephone & Telegraph Company, spent a few days in Chico last week.

A. M. Irwin, assistant to the treasurer of the Westinghouse Electric & Manufacturing Company, has returned to San Francisco from Los Angeles.

H. R. Noack, president of the Pierson-Roeding Company, has returned to San Francisco from a very interesting auto trip through Amador county.

S. K. Colby, assistant general manager of the Aluminum Company of America, who has spent the last couple of weeks on the Coast, has recently returned East.

R. B. Mateer, commercial manager of the Southern Sierras Power Company at Riverside, Cal., has been called to Altoona, Pa., by the death of his father.

H. E. Sanderson, Pacific Coast manager Bryant Electric Company, has returned to San Francisco from a short business trip through the Northwest territory.

H. F. Schottler, Pacific Coast representative of the Gorham Fire Apparatus Company, San Francisco, has returned from a short trip in the Sacramento Valley.

E. Newman has charge of the construction work which has been resumed by the San Joaquin Light & Power Corporation on its No. 2 Plant at North Fork, Cal.

W. B. Thomas, formerly salesman with the Fobes Supply Company at Seattle, is now on the sales force of the Electric Appliance Company at San Francisco.

Chas. N. Black, vice-president of the United Railroads, went as far as Panama on Captain Jackling's yacht. Mr. Black arrived at New York on the 6th of this month.

H. B. Squires, Pacific Coast agent for the Cutler-Hammer Manufacturing Company and National India Rubber Company, has returned to San Francisco from Portland and Seattle.

Geo. E. McFarland, president, and H. D. Pillsbury, vice-president of the Pacific Telephone & Telegraph Company, have returned to San Francisco from a short trip to Los Angeles.

E. C. Wilson of the Great Western Power Company at Oakland, Cal., has been made chairman of the committee on electrical features for the Motor Power Show to be held at Oakland, April 26-May 6.

Frank H. Stone, formerly San Francisco salesman for the General Electric Company, and Pacific States Electric Company, has become a partner in the firm of Leedke & Stone, general tours and steamship agents.

C. V. Schneider, president of the California Association of Electrical Contractors, and Frank Somers of the Century Electric Company of San Jose, attended the quarterly meeting of the association at Oakland this week.

H. J. Kennedy, electrical engineer, formerly located at Seattle, where he had charge of the design and construction of the municipal railway, is now at New York City, where he is interesting financial men in Western projects requiring capital.

MEETING NOTICES.

Electrical Development and Jovian League.

J. B. Carlson, manager of the Central Electric Company, as chairman of the March 29th meeting, provided a most interesting speaker in Supervisor J. Emmet Hayden, who gave an interesting account of a trip through Mexico, his remarks being illustrated with a large number of beautiful lantern slides. Miss Ethel Cotton also gave a number of clever character impersonations and anecdotes. Great interest is being manifested in the Jovian Smoker to be held at the Hotel Sutter during the evening of April 14th.

Oakland Jovian Club.

At a meeting of a number of electrical men at the Commercial Club in Oakland on April 1st, it was decided to form the "Oakland Jovian Club." Tribunes F. H. Woodward and B. C. Hill were elected president and vice-president respectively, and A. H. Nylen, secretary. Meetings will be held monthly at Saturday lunches and discussions be confined primarily to matters of electrical interest. Membership is open to any electrical man whether a member of the Jovian Order or not. E. C. Wilson of the Great Western Power Company briefly explained the electrical features of the Motor Power Show to be held at Oakland April 26-May 6th.

Joint Meeting Portland Sections A. I. E. E. and N. E. L. A.

The next regular joint meeting will be held at 8:15 p. m., April 11th, in the Electric Building, Portland, Oregon. The paper of the evening will be presented by M. E. Cheney, E. E., of the Washington Surveying & Rating Bureau, of Seattle, Washington. His subject will be "A Scientific Method of Compiling the Fire Insurance Rates in Public Utility Properties."

The regular bi-monthly luncheon club of the local section was held at the Portland Commercial Club Thursday noon, March 30th. C. C. Chapman made a talk on "Legislation." A. C. MacMicken acted as chairman. Attendance 40. The speaker of the meeting on April 13th will be W. D. Wheelwright and the chairman of the day will be W. D. Spencer.

San Francisco Section A. I. E. E.

The regular monthly meeting of the San Francisco Section of the American Institute of Electrical Engineers was held at the Engineers' Club on March 31st. A communication from Professor J. G. Scrugham, Dean of the College of Engineering, University of Nevada, regarding the Newlands Bill establishing a fund for engineering research in land grant colleges was read and discussed in detail by C. L. Cory. Communication was also read from the secretary of the local section of mining engineers requesting co-operation between the several local engineering societies, this matter being endorsed. Professor Harris J. Ryan of Stanford University then discussed "Transmission Line and Insulator Losses at extremely high voltages," his talk being illustrated by lantern slides. After briefly describing the new laboratory equipment at Stanford University, whereby it is possible to get and experiment with 350,000 volt current at high frequencies, he talked of results obtained in testing the resistance and flash-

over on various insulators. These detailed results will be the subject of a paper to be published in these columns at an early date. The paper was briefly discussed by J. E. Woodbridge, J. P. Jollyman, C. L. Cory and A. H. Babcock, the chairman of the section.

Los Angeles Jovian League.

Colonel Tom Prior, known as the Amusement King of Venice, and for several decades identified in various capacities with large amusement enterprises throughout the country, was the principal speaker at the meeting Wednesday, March 29th. Col. Prior in a very amusing and entertaining talk entitled "Amusing the Common People for Cash," kept the Jovians in a continual uproar with humorous stories, anecdotes and reminiscences of famous actors and actresses with whom he associated in his early theatrical days, when he was manager of the old Chicago Opera House. A feature of the musical part of the entertainment, deserving special mention, was the singing of Miss June Boggs, soprano, who is with the Southern California Gas Company. Her artistic rendition of several semi-classical ballads was a real musical treat. Paul D. Howse, general manager of The Electrical Products Corporation, as chairman of the day, was responsible for the program, which was one of the most interesting of the year.

AMERICA'S ELECTRICAL WEEK POSTER COMPETITION.

Two thousand dollars in prizes is offered by the Society for Electrical Development, 29 West Thirty-ninth street, New York, in a contest to secure an appropriate poster design for America's Electrical Week, the nation-wide trade movement to be held by the united electrical interests from December 2d to 9th. The competition began April 1st and will close June 1, 1916. The design must not only embody the element of beauty but must carry an appeal, a message striking and convincing, visualizing the triumphs of electricity and its rapid progress in the upbuilding of industrial, commercial and domestic efficiency.

The prizes offered include (A) \$1000 grand prize, (B) \$300 second prize, (C) \$300 public choice prize, (D) \$200 art students' prize (E) \$200 school prizes.

Certain conditions, rules and requirements must be complied with by all competitors. A copy of these may be secured from the Society for Electrical Development. The judges who will decide upon the merits of the various designs and award the prizes are as follows: John Quincy Adams, secretary, Municipal Art Commissions; James P. Haney, art director of New York High Schools; Arthur W. Wiener, president, International Art Service; Herbert F. Houston, president, Associated Advertising Clubs of the World; P. L. Thompson, advertising manager, Western Electric Company; Henry L. Doherty, president, The Society for Electrical Development, Inc.

The committee in executive charge of the competition is as follows: Frank H. Gale, General Electric Company; J. C. McQuiston, Westinghouse Electric & Manufacturing Company; E. W. Rockafellow, Western Electric Company; George Williams, Henry L. Doherty & Company, Bankers, executive staff, Society for Electrical Development, Inc.

CIVIL SERVICE EXAMINATION.

The United States Civil Service Commission announces an open competitive examination for laboratorian, for men only, on May 3, 1916, to fill a vacancy in the position of laboratorian at \$3.60 per diem in the machinery division of the Navy Yard, Mare Island, Cal., and vacancies as they may occur in positions requiring similar qualifications at any navy yard or other naval establishment of the United States, or in the Department at Washington, D. C.

TRADE NOTES.

The Mechanical Installation Company of San Francisco has completed a wireless contract on the wrecking-steamer "Greenwood."

The Weidel Electric Company has taken the J. B. Reite wiring contract on Mission street, between Fifth and Sixth streets, San Francisco.

The Thornberg Electric Company of San Francisco has taken a contract for wiring and apparatus of the Rainier Brewery, San Francisco.

M. C. Baker & Son of San Francisco have secured the wiring contract for the Peck & Hill Furniture Company and also Weeks, Howe, Emerson's new store.

The Standard Electrical Construction Company of San Francisco has received the wiring contract for the addition to the Standard Oil Company's building, out of P. J. Walker's office.

Construction of the two new stations of the Pacific Gas & Electric Company, Nos. 4 and 5, at Clipper Gap and near Auburn, will be the means of employing at least four hundred men this summer.

The Electric Material Company, 589-91 Howard street, San Francisco, is now representing the G. & W. Specialty Company, conveying cable, pot heads, disconnecting devices and insulating compound.

The National Electric Company of San Francisco has taken two apartment house wiring and fixture contracts, one on Van Ness avenue and Vallejo street and the other on Jackson and Leavenworth streets, San Francisco.

The name of the Kohlwey Light Company of 237 Powell street, San Francisco, has been changed to Kohlwey, Smith & Alfs Electrical Company. Mr. Smith was with the Electric Motor & Machine Company; Mr. Alfs was an electrical engineer.

The General Acoustic Company has installed a complete dictograph system in the New City Hall of San Francisco, consisting of eight executive or master stations or controls and seventy-six substations. This company has also installed forty-five intercommunicating substations or telephones for Dunham, Carrigan & Hayden Company.

The Novelty Electric Sign Company of San Francisco, owing to new and larger business, are making window and office changes. They have recently taken electric animated sign contracts for the Rialto Theatre, Royal Theatre, New Mission Theatre, Clinton Cafeteria, Marine Grotto, United Cigar Store and the Pioneer Brewery Company.

The Cab Signal and Train Control System, manufactured by the National Safety Appliance Company, has been installed on several miles of Western Pacific tracks on the Oroville division and twenty engines of the company have been equipped and placed in operation with the signal system on March 6th. This is the result of a successful demonstration of the efficiency of this system made some time ago.

The "Ironclad-Exide" battery, now in its sixth year of successful service, has again been improved by an air-tight cell cover and filing plug construction which has many distinct advantages. This new cover construction prevents dust or other impurities from getting into a cell. The cover is flush with the top of the jar leaving no space for the collection of moisture or dust. It limits the amount of water that can be put into a cell to the exact amount needed to replace that lost by evaporation and keeps the battery dry, overcoming the slopping and spilling of electrolyte, and thus eliminates short circuiting, rotting of battery trays and corrosion of metal parts. The filling plug can be loosened and removed or replaced and tightened by only a quarter turn. Sealing nuts on the terminal posts hold the cover firmly in place, while the use of rubber washers around the posts makes it, (the cover), air tight.



NEWS NOTES



INCORPORATIONS.

SKAMOKAWA, WASH.—The Wahkiakum County Co-operative Telephone & Telegraph Company has been incorporated here.

CARSON CITY, NEV.—The State Electrical Company has been incorporated here with a capital stock of \$1,000,000, by Wm. Muller, P. E. and J. G. Ellis.

MODESTO, CAL.—The Modesto Gas Company has been incorporated with a capital stock of \$100,000 by C. J. Cressey, A. B. Shoemaker, W. A. Harter, J. S. Tully et al.

OTHELLO, WASH.—Application for letters of incorporation has been filed with the secretary of state by the Farmers' and Merchants' Telephone Company, an Othello organization that proposes to build a line from Othello to Cunningham to connect with the Bell system. Applications will also be made for installing a telephone exchange in Othello.

FLORENCE, ARIZ.—The Consolidated Florence-Casa Grande Water Company has been organized with a capital stock of \$250,000. The purpose of the organization is to build a diversion dam on Gila River and to construct a canal to divert water to a point accessible to the existing canal systems. The incorporators are: A. E. Vinson, J. F. O'Connor, W. J. Schultze, F. G. White, J. J. Fraser, Dugald Stewart, Chas. Stewart, H. H. Freeman, W. S. Prouty, J. F. Brown, Archie Ryan, Amandus Peters, G. W. Burgess and W. Y. Price.

ILLUMINATION.

HAILEY, IDAHO.—The new street lighting contract requires the immediate installation of a new lighting system that will cost \$7000.

WALDPORT, ORE.—An ordinance has been passed by the city council granting a franchise to L. H. Evans, to construct and operate an electric light and power plant.

SOCORRO, N. M.—The Magdalena Lighting Company's plant has been sold by order of the district court to George Keith and Ed. Wayne of Socorro, for \$10,000.

COLFAX, WASH.—A movement is under way to incorporate a water and light company in Ewan to take over the present light plant, and to lay water mains over the town.

PASADENA, CAL.—The contract for installing ornamental lighting posts on Bellevue Drive have been awarded by the city commission to W. A. McNally & Company at \$1840.

LOS ANGELES, CAL.—The supervisors have adopted specifications for additional lights in the Westgate district, and bids will be received up to April 10th for the proposed improvement.

MODESTO, CAL.—Sealed bids will be received by the city clerk up to April 11th for furnishing the necessary appliances and electricity required for lighting streets, etc., of the Denair Lighting District for a term of five years.

LOS ANGELES, CAL.—The city council has authorized the board of public works to issue a permit to E. L. Doheny and other property owners to erect, by private contract, ornamental electric light poles along West Adams street, between Figueroa and Hoover streets.

CENTRALIA, WASH.—Charles A. Harmony, who has purchased the properties of the Shelton Electric Company at Shelton, for five years was city electrician in Centralia. After that he was district superintendent of the Washington-Oregon Corporation, now the North Coast Power Company, with headquarters in this city. He has had wide experience in electrical work.

OREGON CITY, ORE.—A special meeting of the city council to be devoted entirely to discussion of the practicability of a municipal light and power plant, operated by power from the falls, is being considered by Mayor Hackett.

Mayor Hackett urges that the city not only generate electricity for street lighting, but also enter into the commercial light and power business. One of the provisions of the agreement between the Hawley Pulp & Paper Company and the city is that the city shall have sufficient room in the new Hawley mill to install generators with a capacity of developing 5000 h.p. water wheels, pumps and other machinery. The city has title to water power at the falls and could secure additional rights by condemnation, according to local attorneys. The only factor that makes Mayor Hackett hesitate in advocating unconditionally the construction of a municipal power plant is the financial condition of the city. The city at present is paying more than \$4000 a year for street lighting alone.

TRANSMISSION.

RIDDLE, ORE.—An ordinance has been passed by the council granting to A. E. Brais a franchise to construct a pole and wire line and underground conduits for distributing electric energy and power in the city of Riddle. A 250 h.p. plant is contemplated.

MADERA, CAL.—Extensions amounting to over \$20,000 are being made by the San Joaquin Light & Power Company in the Raymond, Knowles and Coarse Gold districts of Madera county. Two new substations are being put in by the company, one at Knowles and one at Coarse Gold. Each substation will handle 30,000 volts. The Coarse Gold station is being put in for the operation of the mines, and will, it is expected, in the near future, also serve the town of Coarse Gold. The Knowles substation will serve the quarries, and a 10,000 volt line is being run to Raymond to serve the town, which has never had electric lights or power.

TRANSPORTATION.

POCATELLO, IDAHO.—The city council has granted the Pocatello Traction & Interurban Company a franchise to construct street railway.

LOS ANGELES, CAL.—An extension of the Pacific Electric tracks from Claremont to Uplands, a distance of a mile and a half, has been announced by officials of the road.

BOISE, IDAHO.—An electric railroad from Boise to Bruneau and Wickahoney is a probability now, as a movement is under way to organize a company to construct the road.

PENDLETON, ORE.—An electric road from Pendleton to Walla Walla and from Cold Springs through Pendleton to Bingham Springs is an undertaking projected by an association of capitalists represented by C. W. Lefler. It is understood that E. W. McComas of Pendleton is connected with the undertaking.

ALBUQUERQUE, N. M.—Residents and property owners on Duranes boulevard, extending north from this city, want the City Electric Company to build an extension during the coming summer. North Fourth street property owners are also seeking trolley service. The company is ready to extend its line on one of these streets, but does not deem it advisable to undertake both extensions at the same time.

RED LODGE, MONT.—Plans for the construction of an electric railroad between Red Lodge and Bear Creek and Red Lodge and Columbus were received at a recent meeting of the chamber of commerce, when W. E. Hymer announced that D. E. Thompson of Lincoln, Neb., who is interested in the project, is expected here shortly for the purpose of looking over the country. A committee consisting of Chas. H. Draper, Geo. A. Jeffery, R. G. Wigenborn and others was appointed to confer with Mr. Thompson when he arrives.

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MILITARY ENGINEERING.

BY CAPTAIN RICHARD PARK.

SOME PROBLEMS ON INDUCTIVE INTERFERENCE

BY A. H. GRISWOLD, L. P. FERRIS AND B. W. MASTICK.

FEASIBILITY OF WESTERN ELECTRO-METALLURGY.

BY DORSEY A. LYON AND ROBERT M. KEENEV.

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MILITARY ENGINEERING

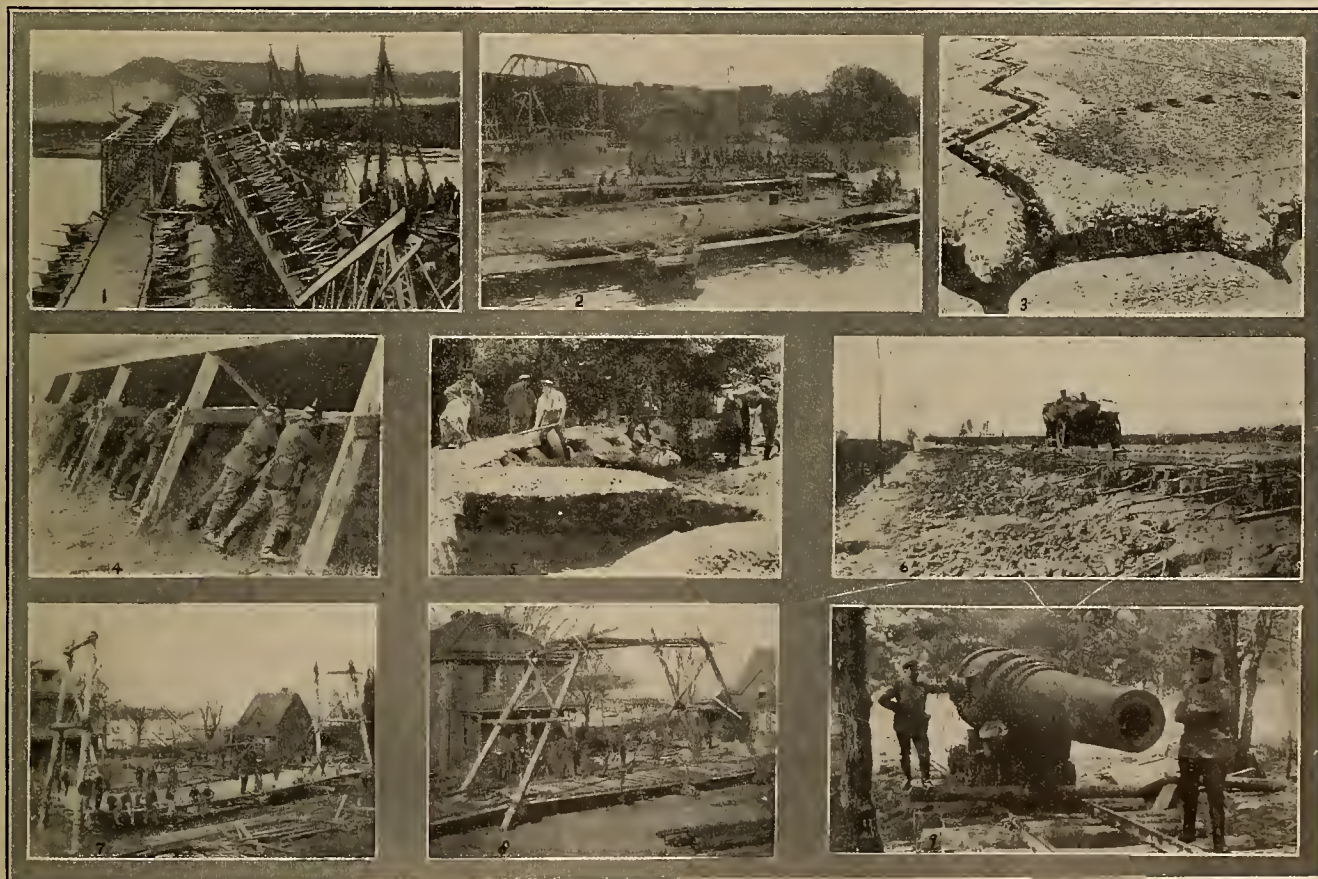
BY CAPTAIN RICHARD PARK,
Corps of Engineers, U. S. Army.

(This article is an abstract of a paper read before the Engineer's Club of San Francisco, March 6, 1916. It deals with the problem in general and specifically with civil engineering conditions. The concluding portion, to be published next week, discusses matters of electrical interest.—The Editor.)

Modern warfare is essentially an engineering problem. Engineers of one class or another have designed and constructed the great guns and mortars of the artillery, the powerful rifles and machine guns of the infantryman. They have invented and perfected the

ties that make warfare on a vast scale possible, and make it so terrible.

Justly therefore are they called upon to play an important role in campaign and on the field of battle. It has long been recognized that technical troops form



Military Engineering Construction Feats.

- (1) Ponton Replacing Dynamited Bridge Across Vistula River, (Photo. illus. Press Co.); (2) Practice Ponton Construction; (3) Zigzag Trench Alignment, (Photo. Underwood and Underwood); (4) Trench Protection with Steel Plates on Timber Frames; (5) Typical Trench Construction; (6) Corduroy Road, (Photo. illus. Press Co.); (7) Double Lock Trestle Bridge; (8) Suspension Type Bridge; (9) Track Construction for Big Guns, (Photo. Underwood and Underwood.)

automobile and the autotruck, made possible the telephone, the telegraph, and the wireless, and have built the roads and the railroads over which armies and their supplies must be moved. Engineers are responsible for the devices and for the transportation facili-

a necessary part of modern armies. The technical troops of our army consist of the Signal Corps, the Ordnance Department and the Engineer Corps.

According to the provisions of the U. S. Army regulations the Corps of Engineers is charged with

reconnoitering and surveying for military purposes, including the laying out of camps, the construction and repair of fortifications, the installation of electric power plants connected with seacoast batteries, the design and operation of field searchlights, and the planning of defensive and offensive works of troops in the field. Within the theatre of operations in time of war it has charge of the construction and repair of wharves, roads, ferries, bridges and incidental structures, and of the operation of armored trains. They further conduct preliminary examinations and surveys for river and harbor improvements and execute such of these works as are authorized by Congress—and also such other duties as the President or Congress may order.

About the only military engineering carried on in time of peace with which the general public is familiar is the construction of seacoast defense works. The fortifications are constructed by the engineers so far as purchase of sites, concrete work, parapets, cover, power plants, and electrical installations are concerned. The guns are mounted by the Ordnance Department, the Signal Service installed by the Signal Corps and the batteries turned over to the Coast Artillery for manning. The seacoast batteries at the entrance to San Francisco Harbor illustrate this class of work. Due to the features, such defensive works must be constructed in time of peace.

Military Map Making.

One of the most important duties of the Corps of Engineers is that of military map making. They should bend every energy to get the money and the personnel necessary and provide accurate maps of theatres of operation before war comes. They must in time of war often make up for a lack of these by mappings as they march in the face of hostile armies, for which work of course only men trained in peace time in the principles of surveying will be of use. Those who are topographers, surveyors, draftsmen, computers, photographers, road engineers, landscape engineers and the like will in time of war find ample use for their profession, both preparing reconnaissance maps of probable battle areas, working with the advance guard of the fighting forces, and also preparing by more accurate methods maps of probable theatres of operation not yet attacked by the enemy.

Why should it not be a proper preparedness movement for engineers skilled in map making and reconnaissance work in the use of the transit, level, computers' tables, and drafting instruments to place their names on a paper organization as military topographers, ready to report for mapping duty on the outbreak of war. Should war break out tomorrow, threatening the west coast, the unmapped or poorly mapped portions of California, Washington and Oregon, would be immediately surveyed under the direction of engineer officers. Such work would require the organization of hundreds of mapping parties using thousands of topographers and thousands of surveying instruments of all kinds. Money would be provided in plenty for doing this work. How quickly and efficiently our start could be made if we had prearranged working plans for the work.

There have been lessons in war teaching the value of accurate military maps of a theatre of operations.

In Natal in January, 1900, the ignorance of the topographical details of a comparatively small area cost thousands of lives. The country between the Upper Tugela and Ladysmith, although it had been in British possession for upwards of half a century, was unsurveyed and unknown.

In many battles during the Civil War officers and troops maneuvering into position lost their way on account of faulty maps.

The Japanese owed much of their success in the Russo-Japanese war to the fact that they had prepared before the war, excellent maps of much of the Manchurian country, and to the fact that they had captured excellent Russian maps of the rest of the theatre of war.

The deadlock on the western front of the European war today is due primarily and directly to the fact that both sides have accurate military maps of the war theatre. For years these maps have been in their possession and have always been kept up to date. From a study of these maps and a study of the ground covered by these maps during the years preceding 1914, the chiefs of each army knew every essential topographical characteristic of the frontier region and deep stretches east and west. Utilizing these splendid maps, the French and Germans for years before the war fought possible battles on paper. The war chiefs of France and the general staff of Germany each figured in secret what measures the other could take to oppose attacks at all possible points portrayed on their maps and with different numbers of troops. Each on his own frontier practiced these battles in maneuvers. Through years of such study every possible solution of each of those problems was studied out on paper by the use of maps and proper plans were made beforehand for their working out in actual war. Each army knows that the other army is well acquainted with all these solutions. The element of surprise is therefore largely done away with, and the armies of the opposing forces being of the same potential strength and equally well led—the deadlock ensues and the struggle becomes one of resources. Think of where France would have been today, had Germany had these maps of her own country and of France, and made these solutions of map problems in time of peace, and France been without the maps and the studies which they permitted!

Laying Out of Camps.

Taking up now the laying out of camps, the Engineer Officer must know the number of troops he has to provide for and the amount of room necessary for the camp of each organization of the command. The general location for the camps will be chosen from the map by the officer in command of the troops, but it will be the duty of his engineers to select the definite camp sites, designate the places for obtaining drinking water, water for cooking and for animals, also the places where bathing and washing clothes will be allowed.

He must get the advice of medical officers as to the fitness of water for drinking purposes. If unfit in its original state proper arrangements must be made for filtering, or sterilizing it.

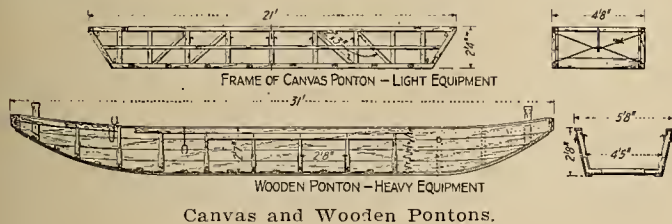
It is very important that proper sanitary arrangements be provided for at the very beginning of the

occupation of a camp. It is just as important that pure drinking water, protection from flies and mosquitoes, and proper sanitary arrangements be provided for a one or two nights' camp as for a semi-permanent camp of long duration. In a short camp very simple but nevertheless adequate sanitary measures suffice, while in a larger permanent camp, will be found modern water supply systems, and elaborate sewage disposal plants.

When a camp is to be occupied during the winter season in a cold climate, it will be necessary for the engineers to design and supervise the construction of housing arrangements more substantial than tents. Huts would be built in this country out of lumber or galvanized iron which the Quartermaster Department would be called upon to furnish.

Movement of Troops.

Next comes the work of the engineers with the mobile troops, in connection with the transportation and movement of the armies. This has to do with the construction, repair and maintenance of roads within the theatre of operations, and bridges, ferries, forts, water transportation, railroads, and other facilities necessary for the rapid and uninterrupted movements of troops. Road and bridge work is most important in an offensive campaign where the march is through territory recently abandoned by the retreating enemy, who has done everything possible in the way of destruction of transportation facilities. It is the function of the engineer troops with the advance guard, to clear away obstructions, repair bridges, pro-



Canvas and Wooden Pontons.

vide ferries, in short to do everything possible to enable the troops in rear to keep on the march. Such work must then be performed with all possible speed. Our bridge outfit consists of a heavy and light train. The light train contains the necessary equipment to construct a substantial roadway supported on canvas boats or pontoons made up of collapsible forms and rectangular pieces of heavy canvas. Enough boats, bunks, and flooring must be carried with the advance troops to insure the spanning of the widest stream. The light bridge will pass cavalry on infantry, the regular wagon trains and light artillery. The heavy train uses heavy wooden pontoons and heavier bunks or stringers, and is of a strength sufficient to carry the heaviest trains likely to be found with an army.

It would be impracticable to carry enough portable bridge material to span many wide streams at the same time, so just as soon as the necessary material can be collected these floating bridges are replaced by trestle, pile or suspension bridges, or by other floating bridges using boats and barges found on the stream, and timbers cut in the forests or furnished from the rear. The released bridge train is then dismantled, loaded up and rushed to its proper place near the head of the column. The pontoons of the bridge trains in

addition to their use as floating piers in a substantial bridge are employed as single boats for the transportation of the head of the column to the opposite bank, or in groups of two or three, furnished with flooring and used as rope or trail ferries.

An enterprising enemy in retreat will endeavor to blow up or otherwise obstruct a road-bed in addition to demolishing culverts and bridges. A great deal of damage can be done by explosives to roads through marshy areas by destroying the road-bed. This will call for corduroying or temporary repair by brush work before wagons can be passed. In defiles, roads can be blocked by explosives blowing in huge masses of the adjacent hillside or cliff. A road cut along the precipitous sides of a ravine or cliff can be effectively blocked by dynamiting the road-bed into the ravine below, necessitating the bridging of the gap, or the cutting deeper into the cliff before the traffic can be resumed. A tunnel can be completely blocked by the judicious use of dynamite. Roads through forests can be blocked by felling trees across them.

The speed with which the engineer overcomes such obstacles and opens up the road again will be a measure of his efficiency. There is no time to draw up elaborate plans for reconstruction. He must decide at a glance as to how best to go about the work of repair. He may see at once that the destruction is so complete that that particular route can not be opened up in time to be of any value, and that the army behind must choose another road. Generally, however, he finds a way to get through. If a tunnel through a mountain spur is blocked, he sees that there is a chance to dig and blast a road around the spur, making use of all the troops as they come up. If a high trestle across a canyon is gone, he at once picks out a possible ramp down one side and a site for the ramp up the other side. Possibly he can with less delay construct a suspension bridge, using the wire cable and tools in his tool wagons, and the growing timber near at hand. The culverts can usually be replaced either by filling with brush and earth, or by felling trees for stringers and using poles and brush for the flooring. Ravines up to 45 ft. wide can be spanned rapidly by means of the single lock or double lock spar bridge, built of logs felled near by, and the frame-work lashed together with the manila rope carried as a part of the equipment. Fords get rapidly cut up and rendered impassable by the passage of the army trains. They may be obstructed by the enemy, placing therein harrows with spikes turned upward, by wire entanglements, or by dynamite. The solution is to find another ford nearby and prepare the approaches, or by means of brush mattresses and fascines again make the damaged ford passable.

These temporary and makeshift repairs by the engineers with the advance guard, are improved by the rest of the engineer troops with the mobile army, in order to facilitate the transportation of reinforcements and supplies, and as the army continues to advance and the roads and bridges first repaired are left well in rear and come under the control of the commander of the line of communications, it is the duty of his engineers to improve the roads, open up the tunnels and replace the improvised bridges with more permanent structures.

Skilled practical engineers are needed in this class of work, not only for the design but for the actual construction. The army engineer in charge of the repair of destroyed works wants trained subordinates from the next in command down to the man who handles the riveting machine or the road scraper. If his engineer officers are trained civilians who have been bridge engineers, hydraulic engineers, highway engineers, mining engineers, construction engineers, if his soldiers are recruited from civilians trained in practical engineering construction work, naturally the bridge will be replaced, or the road, canal, drainage system reconstructed, the tunnel opened up—in a better, more substantial way, and in quicker time, than if his officers are recruited from lawyers and ministers, and his soldiers from farm-hands or garment workers. Bridge-builders, machine men, highway engineers, irrigation and hydraulic engineers, mining engineers, in short, construction engineers of various classes, could organize in some way so that their special qualifications can be made use of in time of war, with the engineer troops who will be assigned this class of work.

It is hardly the function of the engineers with the advance troops to repair railways, except in so far as such work helps along or is necessary in connection with road work. Railroads are useless without rolling stock and this the enemy will have demolished or taken with him in his retreat, and it would be impossible for advance troops to put a demolished railroad in such repair as to be of any aid in the transportation of the main forces a day's march in rear. Such of the engineer troops as are not needed with the advance forces are however at once put to work repairing the railroad, with such material as can be found in the vicinity. All that can be done by the field battalions is of material aid to the work of the base battalions, who are charged with the construction and maintenance and operations of railroads connecting the main bases with the advance bases. For this work there will be organized railroad battalions, composed of regular and volunteer engineer troops, recruited from civilian locomotive engineers, firemen, mechanics, etc.

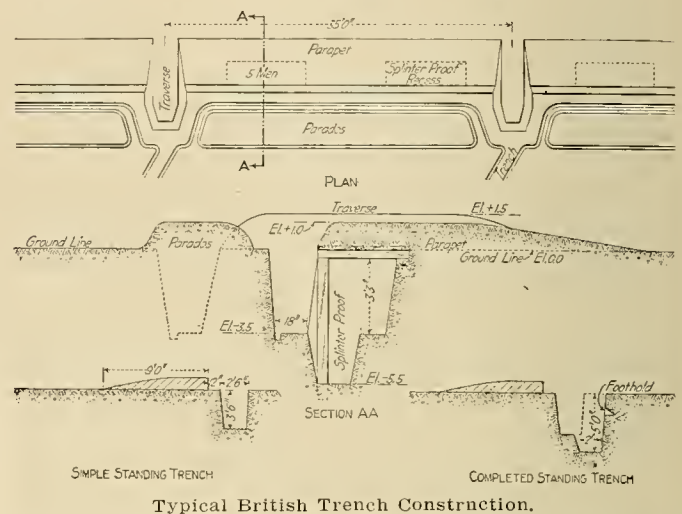
Field Fortification.

By law the Corps of Engineers is also charged with the planning and superintendence of construction of defensive works of troops in the field—which means Field Fortification. Field fortification is divided into hasty intrenchments, deliberate intrenchments and siege works. Hasty intrenchments are defined as constructed by troops usually under fire, in an effort to increase or prolong their fighting power. Deliberate intrenchment comprises works constructed by troops not in line of battle, for the protection of depots, lines of communication, supply, or retreat. Siege works comprise devices used by besiegers and besieged in the attack and defense of strong fortifications.

Less than two years ago it was generally believed, except possibly by Germany that the simple standing trench with a parapet 10 ft. to 12 ft. thick with sufficient head overhead cover to resist shrapnel and shell fragments would be safe against destruction by artillery fire. It was believed that, due to the inconspicuous target, the percentage of hits would be so small and the amount of damage inflicted to any one hit

so little that the amount of ammunition required to destroy an earthwork or render it untenable, would be prohibitive. The Germans in the first stage of the Great War, realizing all this, attacked the French and English works with shrapnel and high explosive shell from 3 in. to 7 in. in diameter, in such astounding quantities from seemingly inexhaustible supplies, that the leveling of the old type of field work was an easy task. It did not take the allies long to acquire on their side, too, a vast number of guns and howitzers of small and large calibre and a supply of ammunition sufficient to destroy enemy works in preparation for an infantry assault.

The tremendous effect of modern field artillery fire has had its influence upon the constructional features. While the general types have remained unchanged, there is now a tendency to make the trench



very narrow in order to present as small a target as possible in the direction of the enemy's fire, and to increase the number of traverses, thus decreasing the length of each section, and localizing the effect of bursting shells. On the other hand, the underground features have been greatly elaborated, due to the necessity for giving the men as much shelter as possible when they are not actually manning the parapet. These features vary all the way from the simple recesses excavated under the parapet of the firing trench to more elaborate works such as tunnels dug between the firing trenches to the cover trenches in rear, or the bomb-proofs of the cover trenches where men may rest safe from anything except the heaviest shells or mine explosions.

The engineers with the mobile troops are not generally called upon to construct the hasty intrenchments; they are dug by the troops who occupy them, and in our army, infantry, cavalry and artillery troops are supplied with tools for this purpose. Engineer officers and soldiers will, however, be called upon to superintend the development of the hasty trench into types that partake more and more of the character of deliberate works. They will be called upon to furnish the tools and the material for the construction of the trench drainage systems, the sanitary arrangement, and other devices in the firing trenches. They will be responsible for the planning and construction of the cover trenches located from 25 to 100 yards in rear of the firing line where considerable protection has to be provided, and they

supervise the digging of the communicating trenches.

The engineers are called upon to design, lay out and construct the deliberate intrenchments necessary in rear of the first line trenches. Such works vary all the way from a single small redoubt defending a stream crossing, to the carefully concealed and elaborately designed series of trenches and redoubts of the second and third lines. These lines on both the east and west fronts of the great war are hundreds of miles long, and you can imagine what their construction has meant in the way of design, superintendence, labor and material.

In close relation to these works there have been carried on by the mobile engineers the railroad, highway and bridge work necessary to complete an elaborate and efficient system of communications between different sectors of the long lines and between all sections of the lines and the central bases.

The particular field fortification devices that were formerly supposed to be used only in connection with sieges or the investment and attack of a permanent fortification, are parallels, approaches and mining operations. Parallels are simply intrenchments dug parallel to the line of defense. The first parallel is dug as soon as the artillery fire of the defense has been sufficiently brought under control. This is a broken line completely circling the fort or forts invested at a distance of about 1200 yards. From the first parallel zigzag trenches, called approaches, saps, or zigzags, are dug toward the enemy and their ends connected by the second parallel 500 yards or so from the enemies' works. From this parallel zigzags or saps are again thrown out to within 300 yards or so of the defense and a third parallel constructed. This third parallel will usually be the position from which the assault will be made. While this surface warfare of trenches and saps is going on the attack is engaged in tunnelling and mining operations underground with a view to firing mines under the walls of the defense and thus providing an opening through which the assault can be made. The defense meanwhile endeavors by counter mines to destroy the galleries dug by the attack, and to demolish their surface works.

The siege of Port Arthur was carried on by the Japanese quite according to the text. In the first days of the present war, however, we saw great fortresses believed to be impregnable, destroyed by a few days' artillery fire from guns and howitzers the like of which we had not known to exist. Apparently it will not be necessary in the future to resort to the slow process of siege works in the capture of fortresses not armed with artillery superior to any that can be brought against it.

Siege works have in former wars been largely confined to attacks on permanent fortifications. Today we see all the devices of siege warfare in use on both fronts against field intrenchments. In former times a siege entailed first the surrounding of the place by mobile troops, so as to cut off supplies and reinforcements, then the preparation of intrenchments, lines of communication in rear, including roads, railroads and rivers, the establishing in position of batteries of siege guns, and then the surface and underground attack by means of saps and zigzags and mines, artillery bombardment, and infantry and cavalry assault. Oftentimes in former wars a place besieged would be

protected on one side by water, and the attack would have to be made by water on that side.

In the world war today the central powers constitute a gigantic fortress, in a state of siege. Where they are not hemmed in by land works the navies of the allied powers have more or less completely invested them by water. The land walls of this fortress are the thousands of miles of trenches which are closely invested by similar works of the allies. These trenches are occupied by millions of infantrymen and cavalrymen armed with rifles, hand grenades and machine guns, they are supported by thousands of guns and howitzers with apparently inexhaustible supplies of ammunition. Military railways, canals, rivers, make easy the problem of communication in rear of all fronts. The air scouts spy out the dispositions of the besieged armies. The elaborate telephone and radio systems, quickly transmit all information to the various army headquarters.

In former wars the besiegers generally had to employ greatly superior forces. They had more men, more guns, more ammunition and a stronger navy. Today the allies have more men, probably more guns, and ammunition, and a greatly superior navy. It remains to be seen whether the allies are strong enough to capture the besieged central powers through infantry assaults through vital sections in their lines, or can invest them long enough and completely enough to enforce the capitulation through starvation.

The construction of field fortifications calls for considerable engineering ability on the part of those in charge. A trench dug through hard pan or stiff clay will require but little shoring up or revetting while a trench through sand or mud will require strong timbering. Due consideration must be given to drainage. Sometimes a gravity system can be devised, regard being given to tactical considerations. Sometimes long stretches of trench must be drained into sumps, and pumps provided to discharge the sump. Suitable water supply arrangements must be designed and constructed.

Competent civilian engineers, enrolled with the army engineers in time of war, will of course have no difficulty in solving the constructional features involved, once the site and type of work has been decided on. Part of his duties with the mobile engineers will be, however, to select or advise the selection of, the location and type of works to be constructed. When these are to be constructed in rear of the first lines and not under fire there will be plenty of time to make a thorough personal reconnaissance of the ground, but when it involves some radical change in the location under fire of a firing trench or the rapid conversion of a captured enemy trench, or of a mine crater just exploded, so as to make it a part of the defensive line, the engineer is called upon to apply his knowledge instantly on the spot. The ability to do this can be obtained only after a thorough study in time of peace of the principles involved.

[To be continued.]

New hydroelectric plants in New Zealand include a 6000 h.p. development at the Wairua Falls north of Auckland and a 58,000 h.p. development at Lake Coleridge, in South Island, about 70 miles from Christchurch.

FEASIBILITY OF WESTERN ELECTRO-METALLURGY.

BY DORSEY A. LYON AND ROBERT M. KEENEY.

Possibility of Success of Electro-metallurgical Industries at The Dalles, Oregon.

It is believed that electric power can be sold profitably by the proposed Columbia River Project at The Dalles for \$10 per horsepower year delivered to the electro-metallurgical plant transformers at 11,000 volts. The consumer is assumed to be located at The Dalles within a few miles of the proposed power plant. The price of \$10 per horsepower year is based upon that price for each horsepower of generator capacity set aside for the manufacturing plant to supply its maximum demand, i.e. the quotation is a flat rate.

Before considering specific industries which might use The Dalles power, we wish to call attention to the fact that while a company which purchases power from a power company has less initial expenditure to make for its plant than if it developed its own power, it is at a disadvantage in operation of the plant. This is because no power company will contract to sell large blocks of power for less than a term of years except on rigid contract, which compels the electro-metallurgical company to pay for the contracted amount of power whether it uses it or not. This is apt to determine the success or failure of an electro-metallurgical company, for in this industry power is one of the most important raw materials. If a company has to pay for this power in a period of business depression, it may very easily be forced into the hands of the receiver by having to pay for power it does not use. It is far worse than being compelled to store large amounts of ore in a stock yard during depression, because the ore can be used, while electric power purchased under these circumstances can not be used except as made. The power goes down the river, and if the power company did not compel its customers to pay for a contracted amount, it would fail financially.

Aluminum.

The process by which aluminum is produced consists essentially of refining hydrated alumina, bauxite, to make a pure alumina by a chemical process known as the Bayer process, and then feeding this alumina into a bath of cryolite, forming the electrolyte, with the result that when direct current is passed through the molten mass, molten aluminum is deposited at the cathode and oxygen given off at the anode.

Raw materials and labor. The ores and other raw materials necessary to the manufacture of aluminum are bauxite, cryolite, fluorspar, coke or charcoal to make electrodes, and coal and caustic soda for purification of bauxite. Of these materials all except coal and charcoal would have to be brought to The Dalles plant from a distance.

Bauxite is mined in the United States in Alabama, Arkansas, Georgia and Tennessee. Arkansas is the leading producer. A plant located at The Dalles would be obliged to depend for its source of bauxite upon some of these Eastern states, as no bauxite is known to exist in the Western United States in large quantities. It has been proposed by some that alunite might become a source of aluminum, but all processes for the extraction of alumina from silicates are still very

much in the experimental stage. About 10 per cent of the bauxite consumed in the United States is imported from Europe. The Southern Aluminum Company with its plant in North Carolina proposed to import all of its bauxite from France during the first few years of operation.

The average price of bauxite per long ton at the mines for 1913 was \$4.75 per long ton. A typical bauxite analyses as follows:

Insoluble	12.13 per cent
Loss on ignition.....	28.97 per cent
Alumina (Al_2O_3).....	57.56 per cent
Iron Oxide (Fe_2O_3).....	1.34 per cent

About four long tons of bauxite are necessary per ton of aluminum, which will cost at the mine in Arkansas or Georgia, \$19. This bauxite if used at The Dalles must be hauled from the east by rail or by rail and water. It is doubtful if raw bauxite would be laid down at The Dalles for less than \$14 per ton. The total cost of bauxite at The Dalles per ton of aluminum produced from it would be \$56. Four tons of bauxite would produce two tons of alumina. The cost of purification would bring the cost of alumina to \$38 per ton of 2000 lb. Two tons of alumina produces one ton of aluminum, so that the cost per ton of aluminum for alumina made at The Dalles would be \$76.

Freight could be saved by purification of bauxite to alumina at the mine or nearby. The cost of alumina at the mine would be about \$19.50 per short ton, or \$28.75 per ton at The Dalles. The alumina for one ton of aluminum would thus cost \$57.50 at The Dalles, a saving of \$9.25 per ton of alumina, or \$18.50 per ton of aluminum made from the alumina.

In the manufacture of aluminum 0.1 tons of cryolite, sodium aluminum fluoride $AlF_3 \cdot 3 NaF$, is consumed by volatilization of the electrolyte per ton of aluminum made. Cryolite is produced only in Iceland. Some aluminum manufacturers substitute an artificial fluoride for the cryolite, using also some calcium fluoride, fluorspar. Cryolite is worth about \$24 per long ton in New York, or 1.1 cents per pound. Shipped to The Dalles cryolite would cost about \$35 per long ton or 1.5 cents per pound.

In the electrolysis of alumina in the electric furnace, the oxygen given off at the anode attacks the carbon electrode with the result that about 0.7 lb. of carbon anode is consumed per pound of aluminum produced. In France and Germany these electrodes are manufactured at the larger aluminum plants from coke at a cost of 2.5 cents per pound. The cost of manufacturing them at The Dalles with coke costing \$10 per ton or charcoal at \$9 per ton would be about 5 cents per pound. Electrodes could be brought from the East or Europe at a cost of 5 to 6 cents per pound f.o.b. The Dalles.

The cost of other materials such as caustic soda or fluorspar will not be discussed here, as the amount used is small, and their cost has been included in other estimates.

Labor costs at The Dalles for manufacture of aluminum will be higher than in the Eastern states or Europe. In Europe \$1 per day is an average wage for laborers at aluminum plants, \$1.50 in the Eastern United States, and \$2.50 in the West outside of mining camps.

Power. The manufacture of aluminum requires direct current so that the use of The Dalles power would mean the transformation of the 11,000 volt current down to a lower voltage for use in a motor generator set. Allowing for transformer, motor, generator and line losses, this would result in the delivery to the furnace from the direct current generator of about 85 per cent of the energy put to the transformers. As the plant would be operating on a flat rate of \$10 per horsepower year for 11,000 volt alternating current, the cost of power at the electrolytic furnace on the basis of 100 per cent load factor would be \$11.76. While it is sometimes stated that an industry like the manufacture of aluminum can be operated on a 100 per cent load factor, this cannot be used as a safe figure in calculating costs. Manufacture of aluminum, however, will maintain a higher load factor than some other similar industries, as for instance electric furnace manufacture of iron and steel, because of the small units employed and the ease of replacing a broken down unit with a new small one without much additional capital outlay caused by keeping reserve units. The largest aluminum furnaces do not require over 150 h.p. for operation, while electric iron and steel furnaces have a capacity of from 300 h.p. to 12,000 h.p. Another point influencing the load factor maintained is the market for the product manufactured. This is especially true of a new company which has to build up its market. When buying power on a flat rate instead of by the kilowatt hour, with a variation of load factor say between 85 and 100 per cent any curtailment of production due to market conditions will result in a heavy charge to the electro-metallurgical company for power which they are not using. For this reason a load factor of 90 per cent is assumed in calculating the cost of power. This would increase the cost of direct current at the aluminum furnace to \$13.06 per horsepower year, or 0.2 cents per kilowatt hour.

Cost of production. Our estimate of cost of production of aluminum at The Dalles is based upon a plant requiring 25,000 h.p. or more in units of 100 to 150 h.p.

Cost of Production of Aluminum per ton (2,000 lb.) at The Dalles.

2 tons of alumina, \$28.75 per ton.....	\$ 57.50
200 lb. of cryolite at 1.5 cents per lb.....	3.00
1400 lb. electrodes at 5 cents per lb.....	70.00
Other fluxes, etc.....	10.00
28,000 kw.-hr., at 0.2 cents per kw.-hr.....	56.00
Labor.....	70.00
Repairs.....	10.00
Amortization, depreciation, 5 per cent each.....	18.00
Interest, 6 per cent.....	10.00
General.....	20.00

Total \$324.50 per ton or 16.22 cents per lb.

Allowing \$15 per ton for freight to New York and \$20 per ton for marketing expense, the total cost per ton f.o.b. New York would be \$359.50 per ton, or 17.98 cents per pound, in round numbers 18 cents per pound.

Market. The aluminum market of the United States is New York City. The average price for No. 1 ingot metal at New York during 1913, generally for spot metal rather than future deliveries, is stated below:

Average Price of Metallic Aluminum at New York City in 1913
in cents per lb.

January	26 1/8—26 5/8
February	25 4/5—26 1/8
March	26 5/10—27 3/10
April	27 —27 3/8
May	26 3/10—26 3/4
June	24 3/4—25 1/4
July	23 1/8—23 4/5
August	22 7/10—23 3/10
September	22 —22 3/8
October	20 —20 6/10
November (first half of month).....	19 1/2
November (last half of month).....	19 1/6—19 2/3
December	18 7/10—19 3/10

The tariff act enacted in October, 1913, placing a duty of 2 cents per pound on ingot aluminum instead of the previous duty of 7 cents per pound, resulted in the price falling in October of that year to 20 to 20½ cents per pound, and as low as 18 7/10 cents in December. The New York price on September 12, 1914, was 20 to 20½ cents. The above quotations are indicative of transactions in the open market, especially as made by dealers in foreign aluminum. The average price of contract aluminum was 1 to 2 cents per pound less than prices given. Hence it is evident that in order to avoid a shut-down in dull times a company manufacturing aluminum at The Dalles should be able, if necessary, to sell its aluminum in the New York market at a price of 18 cents per pound.

A plant at The Dalles would have competition in the New York market with a domestic production at present of 42,000,000 lb. of aluminum, and imports of about 30,000,000 lb. The domestic production of aluminum will be increased by at least 10,000,000 lb. per annum in 1915 when the Southern Aluminum Company starts its plant, and by 10,000,000 lb. more when the plant is completed. So that inside of two years all of the present imports except 10,000,000 lb. will be supplied by a domestic producer. As the plans of the Aluminum Company of America contemplate doubling their present capacity at a plant in Tennessee, this will eventually add a possible production of 40,000,000 lb. per annum or a total future output of 30,000,000 lb. more than the present market demands. Thus it is clear that any company starting business now will have strong competition to meet in several years, which would be from the very start of its operation, as its plant could not be completed for several years. This competition would exist in spite of the fact that the consumption of aluminum in the United States has increased at the average rate of about 7,000,000 lb. per annum for the last five years. While at this rate of increase of consumption, contemplated increased output would no more than supply the domestic demand, it is not probable that the consumption will maintain quite as high a rate of increase. Foreign manufacturers will also be much more active in the New York market in the future owing to the decreased tariff.

Conclusions. We are of the opinion that the utilization of Columbia River power in the manufacture of aluminum would not prove very profitable to the manufacturing company for several reasons.

While the price of power at \$10 per horsepower year, on the 11,000 volt alternating current circuit, is low in cost, the high freight charges on raw materials and product, and increased labor costs over eastern wages, are such as to raise the cost of production so

high that in periods of depressed market the cost of aluminum made at The Dalles would about equal the lowest selling price. Our opinions are further strengthened by the fact that invariably manufacturing costs increase in times of business depression due to decreased output; also as this plant would buy power on a flat rate basis, any decrease in output would result in a great increase of unit cost, due to the continual charge for power regardless of its being used.

A study of the preceding data shows that freight rates on raw materials, supplies and product have contributed largely to the cost of production at The Dalles. While India bauxite might be shipped to The Dalles very cheaply, little is known about these deposits, and their development is in the distant future. An example of the cost of materials due to freight is in electrodes. They can be purchased in the East at 5 cents per pound. On the basis of 0.7 lb. consumption of electrode per pound of aluminum, the cost of electrodes at 5 cents per pound increases the cost of aluminum by 1.4 cents per pound.

Labor cost would also be considerably higher in the West, as previously stated. Technical men in the West such as chemists and engineers also receive a higher rate of pay.

All of these factors have contributed to the raising of our estimate of cost of production to 18 cents per pound f.o.b. New York. At the low price of aluminum in 1913 a company at The Dalles could about break even if it sold its product. At a price of 20 cents per pound a profit of 2 cents per pound would be made. A production of 10,000,000 lb. per annum would require a plant costing about \$4,000,000. This production would give a profit of \$200,000 per annum, or 5 per cent on the actual investment. We consider this to be much too low a margin of profit for safe investment due to unforeseen conditions which might arise and increase the cost. Estimates previous to operation are usually found to be low in practice. It is probable that the Eastern producer could sell at a profit at 18 cents per pound, for it has been estimated that the cost of production of aluminum at Niagara Falls is about 15 cents per pound.

In regard to market conditions, we believe that a new company starting manufacture of aluminum would meet strong competition. The removal of the tariff and the establishment of a plant financed by French capital in the United States has resulted in much competition for the local market. Competition will be still much stronger when plants now in course of construction are completed.

A company now a producer of aluminum with a market for its product and an intimate knowledge of the industry could possibly manufacture aluminum at a small profit at The Dalles, but we can see no advantage for such a company coming to Oregon at the present time or in the very near future, as long as they are able to secure power near the ore and market, as they are able to do at the present time. An established company owning its bauxite supply and having a market is the only sort of a concern which, we believe, would be able to operate without losing money in a plant at The Dalles, and they could not make as much as in an Eastern plant.

[To be continued.]

SOME PROBLEMS OF INDUCTIVE INTERFERENCE.

BY A. H. GRISWOLD, L. P. FERRIS, R. W. MASTICK.

(This paper was presented at a joint meeting of A. I. E. E. and N. E. L. A., Portland, Oregon, January 11, 1916. The discussion thereon will be published subsequently.—The Editor.)

Inductive interference may be defined as the resulting interruption or impairment of service over a communication circuit exposed to the influence of the varying electric and magnetic fields surrounding a neighboring power circuit. Exposure arises from co-linearly constructed lines constituting what is generally termed a "parallel" or case of "parallelism."

In the above definition of inductive interference, communication and power circuits are both used in a general sense, communication circuit meaning any circuit used for the transmission of intelligence and power circuit including all circuits transmitting relatively large amounts of energy in comparison with the communication circuit. For the purpose of this paper, which is to present certain aspects of this subject for your consideration, the field covered by the above definition has been narrowed so as to include only metallic telephone circuits and power transmission circuits. Even with this limitation, it will be impossible within the scope of this brief paper to do more than touch upon the important features of this problem.

Transient interruptions of service occur in most instances of parallelism between power and telephone circuits, and continuous impairment of service to a large or small extent, is to be expected, unless adequate precautions are observed.

Interruption of service due to the effects of normal steady state operation of a power circuit occurs only under severe or acute conditions. Transient interruptions to service are caused in most instances by such abnormal conditions on the power circuit, as grounds, short-circuits or open-circuits, which largely unbalance the system. In some instances, transient interruptions are produced by such normal operations as switching and the charging of electrolytic lightning arresters. The severe inductive effects resulting from transient disturbances in a power system are oft' times the cause of personal injury to telephone operators and occasionally to subscribers and telephone linemen. In most instances, the injury of operators is due directly to what is familiarly known as a "bat in the ear." In extreme cases, operators have been thus disabled for a period of four months. Aside from personal injury, service is sometimes demoralized by such occurrences which naturally make the operators nervous in performing their duties.

In cases where the disturbance is sufficiently severe to operate the protective devices on the telephone circuits, considerable loss of circuit time is experienced, due to the necessity of replacing the protective apparatus which is generally "blown" simultaneously on a number of circuits and at offices widely remote from the seat of the disturbance.

Abundant statistics are available to show the seriousness of such transient disturbances, but it is desired here merely to call attention to this situation, the seriousness of which will undoubtedly be appreciated without the necessity of burdening this brief paper with statistics,

The remedial measures to prevent such interruptions and damage consist essentially in large factors of safety in the construction of the power circuit and apparatus, and careful maintenance and operation. In cases where line faults develop, the method of location should be arranged in such manner that the fault itself is not energized repeatedly in the process of location, as each time this is done a severe disturbance is liable to be created in neighboring communication circuits. Where possible, switching should be done on the low-tension side of transformers, and the several poles of the switches mechanically inter-connected so as to avoid as far as possible momentary unbalancing of the circuit.

Some methods of charging electrolytic lightning arresters give rise to more severe transient disturbances than others. Charging resistances and the method suggested by the General Electric Company, in the General Electric Review for January, 1913, are recommended. The time of charging arresters can often be arranged for a period when the telephone circuits are least liable to be in use.

Apparently there are no preventative measures which may be employed which will entirely obviate transient interruptions to telephone service where such circuits are paralleled for considerable distances by power circuits.

A continuous impairment of service may result from practically all parallels, due to the normal operating conditions on the power system, unless adequate precautions are taken to the contrary. Such impairment of service is due to the induced currents in the telephone circuits which manifest themselves as noises in the telephone receivers at the terminals of the circuits. You are all doubtless familiar with the humming or singing noise heard on telephone circuits subject to induction, and most telephone circuits on the Pacific Coast are unfortunately so subject to a more or less extent. This impairment of service due to noise is termed continuous, as it continues at all times while the power circuit is in normal operation. The effect of the noise is to decrease the intelligibility of conversation over the affected circuits, thus decreasing their efficiency.

The chief factors which are to be considered in judging the severity of the induction which may be caused by a parallel are:

1. Length of parallel.
2. Separation between circuits.
3. Spacings of conductors of power circuit and of telephone circuit.
4. Configuration of circuits.
- 5 The magnitude, frequency, and character (whether balanced or residual) of the fundamental and harmonic currents and voltages of the power circuit.
6. Unbalance of power circuit (producing residual voltages and currents).
7. Unbalance of telephone circuits.

The currents and voltages of the power circuit, including harmonics as well as fundamental, may be resolved into what are termed balanced and residual components. Briefly the former are balanced with respect to the earth as a point of reference, the balanced currents, for instance, being confined in the case of a three-phase circuit to the three line conductors and

excluded from the earth. In the case of residual components the power circuit as a whole is raised above ground potential, the ground thus forming one side of the circuit, therefore the power circuit is for residuals equivalent to a ground-return single-phase circuit. It should be almost obvious that the inductive effects of residual voltages and currents are proportionately greater than the inductive effects of balanced voltages and currents.

In regard to remedial measures to prevent impairment to service over telephone circuits due to the normal operation of power systems the most obviously effective and desirable method is to avoid or eliminate the parallel. That parallels cannot always be avoided or eliminated is recognized by all concerned. With the recognition of this fact we are confronted with the problem of so constructing and operating parallel telephone and power circuits that each industry may be unhindered in its development and extension of its network of circuits for the benefit of the public.

It is perhaps fortunate and significant that substantially all interference and impairment of service arises from factors which are non-essential to the practical operation of power circuits. These non-essential factors are the residual voltages and currents, fundamental as well as harmonics, and the harmonics of the balanced voltages and currents. The balanced voltages and currents of fundamental frequency, which perform the useful functions of the power system, cause little damage to parallel telephone circuits and this little can be easily prevented by simple measures. Not only are the factors which are the most damaging to neighboring telephone circuits non-essential to the power circuits but they sometimes cause trouble to the power circuits themselves. Under these conditions it is but just and proper that power companies make reasonable efforts to eliminate these non-essential factors which are so troublesome to their neighbors.

The basic cause of noise in telephone circuits subject to induction is the presence of harmonic currents and voltages in the power circuits. Were it not for the irregularities of wave-form of the power circuit voltages and currents there would be practically no noise disturbances due to the vast majority of existing parallels.

Tests have conclusively demonstrated that the detrimental effect of a given amount of extraneous current in a telephone receiver increases very rapidly with the frequency (approximately as the square) up to about 800 cycles per second, beyond which the detrimental effect decreases very gradually. This increase in the detrimental effect with an increase in the frequency of the extraneous current is very largely a physiological phenomena and the relative detrimental effects of equal amounts of extraneous currents of different frequencies may be termed the physiological factor for the weighting of different harmonics in accordance with their power of interference. It is convenient in weighting all the harmonics to use the fundamental as a basis of reference. There are a number of factors which must be considered in linking the telephone receiver to the generator of the distant power station. Some of these factors are: (1) telephone terminal apparatus factor, (2) telephone line factor, (3) induction factor, linking telephone and power circuits and (4) power circuit factor. The product of all these

factors and the physiological factor will give the relative weights, from the standpoint of inductive interference, which should be assigned to the different harmonics originating in the generator. All of these factors are not accurately known but the net result is undoubtedly to increase the importance of the higher harmonics above that assigned to them by the physiological factor alone. For the purpose of this paper these considerations merely show the great importance of efforts to improve the wave-form of alternating current machinery. The attainment in commercial service of pure sine waves is not to be regarded as practicable. However, it is perfectly feasible to better conditions in this respect in new electrical machinery by a due regard to the details of design which determine the magnitude and order of harmonics produced by rotating machines. It is no criticism of the designers that such has not been the case in the past for the importance of such efforts has not perhaps been sufficiently recognized. Much will be accomplished in this direction if users of apparatus impress upon the manufacturers the importance of improving wave-form, especially as material improvements can in many cases be made at a very small expense. Distortion of wave-form with the consequent introduction of harmonics is inherent with the use of iron-core transformers. The importance of transformers as sources of harmonics is chiefly with respect to triple harmonic residuals introduced by grounded star-connected transformers.

With respect to residuals power circuits fall naturally into two general classes:

1. Circuits operated with a grounded neutral or neutrals.
2. Circuits isolated from ground, that is, normally having no metallic connection to ground at any point.

For the first class of circuits the causes of residuals are:

1. The triple harmonic voltages and currents from grounded star-connected transformer banks.
2. Unbalanced loads to neutral.
3. Capacitance unbalance of the several phases of the circuit.

For grounded-neutral systems the characteristic triple-harmonic residuals are most troublesome and difficult to prevent or minimize. Their magnitude is determined very largely by the type of transformer connections and the magnetic density of the transformer iron. Low magnetic density and the delta-star connection of single-phase units or three-phase core-type transformers are to be recommended in preference to high magnetic density and the star-star connection of single-phase units. Observance of these precautions is, however, no guarantee that harmful interference may not result in cases of severe exposure. The effect of the lines and the interaction of banks of transformers at different points of a large grounded neutral network present a complicated problem, the detailed discussion of which has no place in this paper.

To prevent residuals due to unbalanced load careful attention should be given to the distribution of load upon the several phases and in no case should grounded single-phase loads be permitted.

Capacitance unbalance is generally of minor importance in giving rise to residuals in grounded neutral circuits. Should its effect be of importance it can,

however, be cared for by transposing the power circuit.

Residual voltages and currents in isolated power systems arise from unbalanced capacitance and conductance between the several phases of the circuit and ground. In well maintained power circuits the effect of unbalanced leakage is of minor importance. In an isolated power circuit the voltages to ground are determined by the voltages between conductors and the capacitances between the several conductors and ground. If the latter are unbalanced the voltages to ground will be unbalanced, that is, they will not sum up to zero and if different sections of line are not similarly unbalanced a residual current will be caused. The unbalanced capacitance of a power circuit can be reduced to a negligible amount by transposing the power circuit in such a manner that each conductor occupies each of the conductor positions for equal distances. In other words, a whole number of "barrels" must be installed. The length of "barrel" necessary to effectively balance the circuit is dependent upon the frequency of the prominent harmonics of the impressed voltages, since it is chiefly desirable to guard against the harmonic residuals.

In all cases of parallelism the power and telephone circuits should be rendered as nearly as practicable mutually non-inductive by the installation of coordinated transposition systems upon which reliance is placed to prevent troublesome interference from the disturbing factors of the power circuit which it is not possible to eliminate.

Each side of a telephone circuit subject to induction is raised above the potential of the ground which must be in the case of telephone as well as power circuits, the true basis of reference. The disturbing current in the telephone circuit is due to the differential inductive effect between the two sides of the circuit. Transpositions in the power circuit reduce the induction from balanced voltages and currents by creating mutually neutralizing inductive effects in neighboring lengths of each side of the telephone circuit. They do not affect the induction from residuals since they do not in reality constitute a transposition of the two sides of the residual circuit. Transpositions in the telephone circuit tend merely to equalize the induction in the two sides of the circuit, whether from balanced or residual components, by exposing each side equally to the effect of the power circuit. Where both power and telephone circuit transpositions are employed the effectiveness of this equalizing depends, with respect to the balanced components, upon the relative location of the power and telephone transpositions and it is for this reason that careful coordination of transpositions in the two types of circuit is essential to the success of the method.

The effective application of coordinated transposition systems to the power and telephone circuits involved in a parallel generally requires power circuit "barrels" of from one-half mile to six miles in length, the former figure being exceptional. The number of power transpositions required is very largely determined by the length of reasonably uniform sections of parallel between points of discontinuity such as ends of parallel, crossovers, substations, loading points and branch loads. In regard to the telephone transpositions, it is generally necessary to completely retranspose the telephone circuits within the limits of the

parallel and beyond each end of the parallel to the nearest neutral point in the transposition system. The development of a special system of telephone transpositions has been necessitated by the double requirement of rendering the telephone circuits non-inductive to the power circuit and to each other.

Considering some of the other factors which determine the severity of induction to be experienced in any given case, it is obviously desirable that the separation between circuits be as great as possible. It is also highly desirable that the separation between circuits be as uniform as possible in order that the effectiveness of transpositions may not be seriously impaired. The spacing of the conductors of the power circuit and telephone circuit is important in determining the magnitude of the inductive effects. The conductors of each circuit should be as close together as practicable in order to minimize the induction. The spacing of the telephone conductors employed in practice is now as small as possible, considered with proper maintenance and operation of the circuits. Cases have occurred in which the spacings of the conductors of the power circuit were greatly in excess of anything demanded by the mechanical or electrical requirements of the situation.

The configuration of the circuits, meaning the relative positions of the different conductors, is a large factor in determining the magnitude of the induction per unit length of exposure. The configuration of telephone circuits is practically fixed and uniform, but, on the other hand, there is some choice with respect to the arrangement of the power conductors. Power engineers have indicated their willingness and desire where possible, to adopt a configuration which will give the minimum of induction. Unfortunately, however, the available knowledge as to the best type of configuration and the relative merits of different practical configurations, is very limited.

The unbalance of a power circuit in producing residual voltage and current has been mentioned before. The unbalance of the telephone circuits themselves is of considerable importance in determining the noise in circuits subject to induction. When a telephone circuit as a whole is raised above ground potential, any unbalance of the circuit tends to cause a current through the terminal apparatus, thereby causing noise. The efforts of the telephone companies since the introduction of metallic telephone circuits have been to steadily improve the balance of their circuits until today little practical benefit in the way of noise reduction can be obtained through efforts in this direction. It should be borne in mind that the requirements of telephone circuit operation, entirely apart from the matter of interference by power circuits, necessitate a very high degree of balance in order to prevent mutual interference between the large number of closely associated telephone circuits on the same pole line.

The fact that power circuit transpositions do not reduce the average induction from residuals into the two sides of a circuit, coupled with the fact that a small voltage to ground may produce harmful interference, even with the high degree of balance attained in telephone circuits, renders it important that an effort be made to attain a similar high degree of balance of power circuits, i.e., the reduction of the residual voltages and currents.

Recent developments in California in regard to the inductive interference situation are of present interest. Owing to the spirit of co-operation between the power and telephone companies due to the work of the Joint Committee on Inductive Interference and the adoption by the Railroad Commission of California of the committee's recommendations for rules to mitigate inductive interference; many important induction cases have already been settled amicably and in a manner entirely satisfactory to both parties. The chief benefit of the California rules is perhaps not so much in the rules themselves as in the spirit of co-operation and mutual understanding which has developed as a result of the investigation upon which the California rules are based. It is this spirit of co-operation that should be encouraged between all power and telephone companies, and in which they should meet to overcome the difficulties growing out of inductive interference and adopt remedial measures for the most economic solution of the problem, all things considered, regardless of whether the most extensive changes are necessitated in the system of the power company, or of the telephone company and allowing the division of the costs to be made independently and solely with regard to the equities of the situation.

Electricity at the front is the subject of an article in *l'Industrie Electrique*, which states that the territory in Belgium and France which is occupied by Germans, is rich in factories, with a great many central station supplying electric light and power. The high pressure mains, the transformer stations, and distributing networks have suffered from the effects of the fighting, but as soon as possible after the district is occupied the mains are put in order, and the electric light is brought into use. As there were stocks of coal at the pit-heads, and the pits that were in good condition have been restarted by the Germans, energy is generated at cheap rates. Even before the large power stations had been restored, ingenious soldiers had brought many small installations into use for lighting houses, and the electric light is almost indispensable for hospitals, operating theatres and dressing rooms, bakeries, railway stations, and offices. With the aid of electric power the Germans have been able to thrash quickly considerable quantities of corn, to drive their workshops, and to carry on a variety of important services. As coal cannot be used at the mines in the neighborhood of hostile artillery for fear of attracting attention by the smoke, winding engines have been driven by electric power. In the stables chaff-cutters have been driven by motors, and the dentists in rear of the front use motors to ply their art. In some cases, places which before the war were not electrically lighted have been provided with installations. The use of electricity at the extreme front line is particularly important. In spite of the difficulty of laying mains to the firing line, electric pumps are often used to clear the trenches of water; electricity has also proved most useful in tunneling for mines quickly and silently, a matter of great importance, besides making it possible to ventilate long and narrow underground galleries. Electric light is also used in the trenches and dug-outs.

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The most remarkable feature of the California Railroad Commission's refusal to allow the Pacific Gas & Electric Company to declare a common stock dividend has been the rapid recovery from this attack on the corporation's credit. The unexpected tenor of the decision, amounting to a complete reversal of former policy, temporarily disturbed the stability of all securities, particularly those which were ostensibly to be protected by the decision. But the company's past efforts to comply with the spirit of the commission's requirements has evidently and justly earned public confidence.

How to live amicably with one's mother-in-law is, on a large scale, the problem that confronts a public utility corporation trying to build better public relations. The very fact that a utility and the public quarrel so readily would seem to prove that they are relations. Just what kind of relations, friendly or otherwise, is largely dependent upon the attitude of the utility. This view is worth analyzing, for it leads to some remarkably simple conclusions.

Fundamentally, the problem of creating better public relations is the same as that of creating better private relations. The great public is merely an aggregate of families, yours, and your neighbor and your neighbor's neighbor, ours, and our neighbor and our neighbor's neighbor. The chief reason why more cordial relations have not been established, that greater confidence does not exist, is because the public has usually been considered in the abstract, as an aggregate, instead of in the concrete, as individuals.

The things that appeal to and govern the action of a child, likewise affect a crowd. The public is human, it has a universal consciousness and an innate sense of fair play. And today the man who would successfully develop a public utility should be a man with human sympathy, human understanding and super-human faith. These qualities are necessary on a small scale in building up the organization, in developing the corporation spirit, and on a large scale in winning and holding public confidence. The individual is a product of the group, and the group a multiplication of individuals.

Every official and employe of a public utility company has the opportunity to be individualistic, to be a leader in thought and initiative, and to demonstrate that not only do the parts exist for the whole but also that the whole exists for the parts. It is necessary for them to cultivate greater insight, sympathy and comradeship and acquire the perspective of true service. This spirit is being truly exemplified by President Lilienthal of the United Railroads at San Francisco, who "dares to be a Daniel."

This macroscopic conception can be attained only by an enlargement of microscopic action. The same actions which arouse trust, confidence and gratitude in the home will stimulate them in the public, just as inevitably as the reverse actions create distrust and hate. A father practices generosity, forgiveness and

patience to bring about obedience, dutifulness and love in the family. The same thought applies to the management of a public utility in its attitude toward the public. Benevolence begets reverence. The scornful mental attitude on the part of the utility engenders an attitude of fear on the part of the public and creates vindictiveness and watchful suspicion. Substitute the spirit of give for the spirit of take and the public will eventually reciprocate.

The one point in which society in general differs from an integration of family units is that the larger group is without the family bonds. The larger the group the greater is the lack of warm personal feeling. To maintain social harmony it is necessary to find some other bond, to appeal to some other motive, such as that of self interest.

Teach the public that private initiative and responsibility in public utilities is to the best interest of the community. By the exercise of imagination about a city's needs, sympathy with a district's development and loyalty to a territory's cause, stimulate similar ideals in the public mind as regards the utility's part in public progress. Nail every lie about the corporation as soon as it is uttered. And finally, and most important, maintain persistent and consistent publicity. With the remedial means so patent why should the corrective agency be latent?

Peculiar interest centers in the decision of the California Railroad Commission regarding the rates of the San Joaquin Light & Power Corporation. It not only represents the most exhaustive investigation yet conducted as to agricultural power conditions, settling several disputed points, but it will also probably be the precedent for other Western commissions as regards the supply of electric current for irrigation pumping. As certain rules are laid down for the guidance of utilities, a brief summary of the salient features of the decision is of immediate value, discussion on them being deferred until a future issue. The subjects specifically discussed are contracts, valuation and rates.

Most of the decision is devoted to amending the terms of the company's contract with agricultural consumers. In the commission's opinion, an electric utility cannot require a contract as a condition precedent to service, except in unusual cases. The large abnormal investment for agricultural lines justifies a three-year instead of a five-year contract in this case, as also with oil well pumping, mining power and municipal lighting. But no utility can demand a lien on land to guarantee the payment of bills nor require consumers to waive claims for damage caused by service interruption. Neither can the granting of a right-of-way across a consumer's property be demanded before service is given, this being a matter "which should be left to the unfettered bargaining between the consumer and the utility." Furthermore, a farmer may use the full amount of power for other purposes when it is not being used for irrigation if the maximum demand is controlled by a double-throw switch or other approved limiting device.

The commission re-iterated its opinion that the cost of service extensions, consumers' transformers and the relocation of meters should be borne by the utility. It was suggested that payment for existing transformers and meter relocations be made by crediting monthly bills with the value thereof.

The treatment of the evaluation problem, particularly as regards "going concern" value and the valuation of water rights is intensely interesting. In its arguments, the corporation had assumed that its going concern value was at least equivalent to the cost of developing its business, showing that in eight districts this had amounted to \$82.98 per consumer and \$41.58 per kilowatt of connected load. The commission found that no allowance had been made for the fact that the surplus of later years has amortized the deficit of earlier years and consequently disallowed any going concern value. "The tangible property, however, is being valued as property in successful operation by a going and successful utility. It must not be understood from this decision that when a utility's deficits have not been wiped out, the amount of such deficit must be added as going value, or otherwise, to the amount reasonably allowable for the tangible property. Otherwise the most poorly operated property might be the most valuable for a rate case."

The company had included water right values among its assets. These value were based upon the comparative cost of hydroelectric and steam-electric generation and also on the assumed detriment to lower riparian lands caused by storage of water which might otherwise be available for irrigation. The commission found that the application of the substitutional steam plant method proves that the water rights have a large negative value at present and will so continue until the price of oil is at least fifty per cent in excess of the assumed price of fifty cents per barrel. The commission holds that such a theory, based on varying prices of fuel oil, makes the continuance of a stable rate base impossible. As regards the second point, evidence was produced to show that the beneficial regulating effect of the storage reservoir more than compensates for any water deprivation to lower irrigable lands. Finally it was held that in rate cases no allowance should be made for governmental franchises or permits in excess of the amounts actually paid to the granting public authorities.

The final determination of rates was based on an eight per cent return on the valuation. The agricultural power rate of \$50 per horsepower year was reduced to \$42.30 and other rates in about the same proportion. Considerable criticism was directed against the company's methods of determining maximum demand. When the revenue from large power and lighting consumers is sufficient, maximum demand meters are justified, but the operating characteristics of ordinary agricultural, power and residence lighting consumers are now so well known that rates may be safely based on the connected load. Maximum demand readings should be for at least fifteen minutes nor should a single reading govern an entire year's bills. It is suggested that a material saving be accomplished by discontinuing the practice of installing meters on strictly flat rate installations.

PERSONALS

Frank Leach, electrical contractor from Fortuna, Cal., is at San Francisco.

W. S. Berry, sales manager Western Electric Company at San Francisco, is at Los Angeles.

H. H. Hoxie of the Electric Railway & Manufacturers Supply Company is in Southern California.

S. V. Mooney, western manager John A. Roebling Sons Co., is on his way to New York, via Seattle, Wash.

H. J. White, of the firm of Keeler-White, has returned to San Francisco from a trip throughout Southern California.

L. H. Baldwin, of the Kellogg Switchboard & Supply Company, is now representing that firm in Los Angeles, Cal.

E. P. Williams, general manager Colonial Electric Division, Colonial Agency Company of Warren, Ohio, will visit the coast very soon.

F. A. Wood, of the Gamewell Fire Alarm Company, is back at San Francisco after a trip in the northern part of California.

E. N. Brown, manager of the Majestic Electric Development Company, San Francisco, will be in the East for the next six weeks.

H. A. Lardner, vice-president J. G. White Engineering Corporation, has returned to the New York office, where he expects to remain some time.

A. J. Myers, Pacific Coast manager Wagner Electric Company of St. Louis, who has been visiting their factories, has recently returned to San Francisco.

C. W. Atkins, at one time with the Electric Maintenance Company, is now in business for himself under the name of the Radio Light Company, at San Francisco.

J. M. Wakeman, general manager of the Society for Electrical Development, has been appointed by Jupiter Thomas A. Wynne, Statesman-at-large of the Jovian Order.

W. J. Davis, Jr., Pacific Coast engineer General Electric Company, and **John Hood**, local engineer at San Francisco, are visiting the company's factories in the East.

J. T. Whittlesey, electrical engineer, Universal Electric & Gas Company, is attending a convention of American S. & M. Engineers in New Orleans. He will return to San Francisco on the 18th of this month.

W. D'A Ryan, illuminating engineer General Electric Company, left San Francisco for the East this week after completing arrangements for the illumination of Market street with ornamental lighting standards.

Geo. R. Murphy, Pacific Coast manager for the Electric Storage Battery Company, has recently returned to San Francisco, after an extended business trip throughout the Northwest.

E. M. Cutting, Pacific Coast representative of the Edison Storage Battery Company, is returning to the coast from a business trip to the home factory by way of Montana, Idaho and Salt Lake.

F. J. Quinn of the Manhattan Electrical Supply Company, has returned to San Francisco from Fresno and Southern California, after having made an extended trip throughout the northwestern territory.

J. C. Zancker of the Zancker Electric Sign Company of Portland, Oregon, has recently made arrangements with the Federal Sign System (Electric) of San Francisco to be their representative in that territory.

Edwin B. Pike, Pacific Coast manager Jefferson Glass Company, of Follansbee, West Virginia, has returned to San Francisco after an extended trip to the factories covering the territory between Portland and West Virginia on his trip east and the southern states on his return.

Clyde B. Aitchison, chairman of the Oregon Public Service Commission has accepted appointment as chief of the valuation department of the National Association of Railroad Commissioners at Washington, D. C. He will resign after the primaries next month. Republicans who have filed their candidacies for the Eastern Oregon nomination for commissioner are H. H. Corey, secretary of the commission, of Baker; Robert Service of Baker, James B. Kyle of Stanfield, Ed. Wright of La Grande, and John P. Rusk of La Grande.

James M. Barry, chief of the Department of Electricity, San Francisco, has placed his offices at the disposal of a committee now drafting a joint pole agreement. **E. J. Kendall**, of the Great Western Power Company, is presiding at the meetings, and **Frederick Smith**, of the Pacific Telephone & Telegraph Company, is acting as secretary. The committee includes: **A. R. Thompson**, **P. J. Wilson** and **S. J. Lisberger**, of the Pacific Gas & Electric Company; **E. W. Beardsley**, Great Western Power Company; **James L. Ord**, Western Union; **H. F. Jackson**, Sierra & San Francisco Power Company; **Samuel L. Foster**, United Railroads; **Paul J. Ost**, Municipal Railway; **Alfred K. Harford**, Universal Electric & Gas Company; **W. T. Teague**, Pacific Telephone & Telegraph Co., and **A. R. Kempston**, Department of Electricity. It has been decided that it would be best in this city to let poles already up remain the property of the companies that have erected them, and to have these companies grant perpetual easements to other companies. Joint ownership will be provided for where several companies wish to erect new poles at the same time.

MEETING NOTICES.

Los Angeles Jovian Electric League.

President **Henry F. Holland** being absent in San Francisco, **Mr. Alan E. Morphy** took charge of the meeting April 5th, and with his unusual brilliancy and good humor quickly turned the luncheon into a real party. **Ross B. Mateer**, commercial agent, The Southern Sierras Power Company, who was to have been chairman of the day, was absent on account of the death of his father, and **K. E. Van Kuran**, district manager Westinghouse Electric & Manufacturing Company, acted in his stead. A delegation from Riverside, representing The Southern Sierras Power Company, was heartily welcomed and short talks were made by Assistant Treasurer **A. S. Cooper** and Purchasing Agent **H. R. Day**, the real orator of the day being **L. B. Potter**, attorney and counsel of the company, whose keen wit and humor made a very favorable impression. His subject was "Co-operation."

Electrical Development and Jovian League of San Francisco.

Advertising was the subject of an interesting meeting of the League on April 5th, **C. H. Tallant**, advertising representative of the General Electric Company, being chairman of the day and **Fred Nelson**, advertising manager for O'Connor, Moffatt & Company, the speaker. Mr. Nelson commended the excellence of the slogan "Do it electrically," as the nucleus for a great publicity campaign. He showed that the cost of advertising, in general, is absorbed in the greater distribution and consequently lessened costs of manufacturing thus produced. He stated that advertising is the most direct line of communication between the seller and the buyer from manufacturer to jobber, from jobber to dealer, and from dealer to consumer. A number of successful advertising campaigns were specifically cited as showing their effect in increasing the frequency of turnover, and consequently of profit. He advocated a co-operative campaign on bill boards, in newspapers and by mail and suggested that the advertising appropriation bear a direct ratio to the gross sales. He also advised that such a campaign be done under the direction of an expert advertising man. His remarks were concluded by a statement that the success of any association is dependent

upon the definiteness of the reason for its existence and that the mission of this league should be to tell people how to economize by using electricity. At the suggestion of S. V. Walton, the secretary was instructed to advise various civic organizations of the league's willingness to provide speakers on electrical subjects.

Pacific Division of the American Association for the Advancement of Science.

During the past year a general association of scientific interests on the Pacific Coast supported by affiliations with a number of Pacific Coast scientific societies has been effected under the auspices of the Pacific Division of the American Association for the Advancement of Science. The first meeting of this Division has been appointed for San Diego between the dates, August 9 and 12, 1916. This will be an event of especial significance to Western scientists because it will be the first of a series of similar meetings which it is planned to hold annually in the various educational centers of the Coast, and because it occurs in a region which presents many interesting features of geology, archaeology, botany and zoology. The officers and members of the executive committee is whose hands are the general plans for the San Diego meeting are representatives of several branches of science: President, W. W. Campbell, Lick Observatory, Mount Hamilton, California; Vice-President, D. T. MacDougal, Desert Botanical Laboratory, Tuscon, Arizona; Secretary-Treasurer, Albert L. Barrows, University of California, Berkeley. Executive Committee—D. T. MacDougal, chairman, Desert Botanical Laboratory, Tuscon, Arizona; W. W. Campbell, ex-officio, Lick Observatory, Mount Hamilton, California; Edward C. Franklin Stanford University California; Theodore C. Frye, University of Washington, Seattle; C. E. Grunsky, San Francisco, California; George E. Hale, Mount Wilson Solar Observatory, Pasadena, California; Vernon L. Kellogg, Stanford University California; A. C. Lawson, University of California, Berkeley; E. P. Lewis, University of California, Berkeley. Among the important addresses to be given at the San Diego meeting of the Pacific Division of the American Association will be that of the president of the division, Dr. W. W. Campbell, director of the Lick Observatory of the University of California, Mount Hamilton, entitled, "What We Know About Comets." Two other general addresses will be given by Dr. F. F. Westbrook, president of the University of British Columbia; by Dr. Barton W. Evermann, director of the museum of the California Academy of Science.

Washington A. I. E. E. Meeting.

A meeting of the American Institute of Electrical Engineers will be held at Washington, D. C., on Wednesday, April 26, 1916, under the auspices of the Washington section and the committee on development of water power. Headquarters will be at the New Willard, and through the courtesy of the hotel management ample facilities have been put at the institute's disposal. Two sessions are to be held, the first beginning at 2:30 o'clock in the afternoon, and the second at 8:15 o'clock in the evening, both devoted to the specific question of water power development as related to national industrial efficiency and preparedness.

This meeting has been suggested by the committee on development of water power, which sees further opportunity for service to the nation by directing the attention of the public and of congress to the fundamental engineering and economic principles that underly the water power question and which must be taken into account if hydroelectric development is to be encouraged and stimulated, with a corresponding effect on the development of the great electrochemical and similar industries which are essential to the industrial independence of the nation.

At the present time congress is considering the enactment of legislation intended to remove some of the legal obstructions which in the past have operated to deter capital

from investment in hydroelectric enterprises, and it would therefore seem to be a peculiarly opportune moment for the institute to be of service. As will be noted from the program which follows, it has been sought to correlate several of those phases of hydroelectric development which are of peculiar and perhaps unusual importance at the present time, while the standing of the authors who have consented to prepare papers insures adequate presentation.

The program for this meeting, as at present arranged, is as follows:

1. Address by President John J. Carty.
2. "Electrochemical Industries and Their Interest in the Development of Water Power," by Lawrence Addicks.
3. Water Power Development and the Food Problem," by Allerton S. Cushman.
4. "The Relation of Water Power to Increased Transportation," by L. B. Stillwell.
5. "The Relation of Water Power to the National Defense," by W. R. Whitney.
6. "The Water Power Situation, Including Its Financial Aspect," by Gano Dunn.

Oregon Electrical Contractors' Association.

The Oregon Association of Electrical Contractors and Dealers, have been holding weekly meetings, but at the last meeting it was decided to reduce the same to two meetings a month and same will hereafter be held at the Electric Building, on the second and fourth Wednesday evenings of each month, the first meeting in each month to be a purely educational meeting and a competent committee consisting of Messrs. J. R. Tomlinson, A. C. McMicken and Mr. Wills, who promise that there will be something doing all the time. The second meeting of the month will be devoted to the business of the association. At the meeting held on March 22d an election of two additional vice-presidents was had, owing to the membership of this district having reached 36 members and Mr. J. H. Sroufe and Mr. Edward Pierce were elected to same. The membership from out the state is increasing; the following applications were received since last meeting: Hunter Electric, Eugene; The Dalles Electric Works, The Apple City Electric Company of Hood River, and Cole & Cummings of Corvallis. The spirit of co-operation is manifest throughout the membership and all believe that this association will accomplish its aims and objects. There has been more than forty already built houses in the city wired under the campaign now in effect and that in the first 15 days.

California Association of Electrical Contractors and Dealers.

The regular quarterly meeting was held Thursday, April 6th, at Oakland, Cal. After disposal of the regular routine business the question of the meeting place for the annual convention was taken up, with the result that Santa Cruz was selected as the convention city, provided the resort hotel is in operation this season. Should this fail to open the city of Stockton was selected as an alternate.

Request was also made that the chairman of the various local sections of the state association be prepared to submit progress reports at future quarterly meetings. It was also decided to keep in close touch with the working of the Federal Trade Commission and secure complete reports of that body's work along cost find and accounting systems for small retailers. Some forty members attended the afternoon session, which adjourned at 5 p. m. to permit attendants to prepare for the open meeting of the evening which was called for 7 o'clock.

W. H. Gribble presided as toastmaster at the banquet in the evening, 97 contractors and jobbers being present. The principal speaker was J. J. Donovan, city architect of Oakland, who spoke on co-operation between the architect and contractor, telling of his own practice in requiring general contractors to submit the list of sub-contractors in order to prevent the peddling of bids. This courtesy carries with it

an obligation on the part of the sub-contractor to deal fairly and squarely with the architect. He urged the contractor to provide a fair margin of profit and suggested the necessity of educating owners to realize the importance of concealed work, such as electrical equipment.

F. E. Newberry spoke briefly of the necessity for contractors carrying on their business in a businesslike way and also commended association meetings. He stated that it had become the duty of contractors to be careful in adding proper allowance for overhead and a legitimate profit to the cost of labor and material.

Geo. B. Furniss, assistant manager of the Pacific Gas Electric Company at Oakland, spoke of the value of associations in development of opportunity. Brief remarks along the same lines were also made by W. S. Berry and C. F. Butte. W. L. Goodwin urged the value of association membership and cited the Federal Trade Commission's commendation of trade associations in general. He said electrical contractors seemed to have a wonderful faculty for not making money. He condemned the National Board of Fire Underwriters for not discriminating between grades of material and suggested that the architects should have a committee to establish quality standards. C. E. Wiggin urged the dealers to energetically follow up sales prospects and then to add a fair profit in order to successfully conduct their business.

S. V. Walton, commercial manager of the Pacific Gas & Electric Company, briefly recounted the progress of the lamp socket device campaign being conducted co-operatively with the jobbers. This is being modified so that all sales will hereafter be made through the dealers, as the Pacific Gas & Electric Company is convinced that dealers are able and capable of handling appliances at retail. A similar policy as regards ranges will probably be inaugurated in the near future. The central station will encourage dealers to sell ranges in districts where there are capable dealers and will confine its selling efforts to districts where there are no dealers. It is likely that other power companies will do likewise. W. L. Goodwin prophesied that \$70,000 worth of ranges will be sold in the western territory during the next 12 months and that this amount would double and quadruple in the second and third year respectively, so that four years from now dealers can figure on handling \$500,000 worth of ranges annually.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The commission has authorized the Western States Gas & Electric Company to withdraw from the Girard Trust Company \$9,114.47 for expenditures.

The Valley Natural Gas Company has applied to the commission for authority to execute a deed of trust to the Anglo-California Trust Company to secure a bonded indebtedness of \$2,000,000 and to issue \$378,000 par value of bonds secured by it. The company seeks to buy the properties of the California Natural Gas Company.

The Riverside Home Telephone & Telegraph Company and the Pacific Telephone & Telegraph Company have filed with the commission an application for the authority for the Riverside company to sell its property to the Pacific company for \$245,382.65.

The Reedley Telephone Company, a sub-licensee of the Pacific Telephone & Telegraph Company, has applied to the commission for authority to issue 951 shares of its capital stock at 90 cents a share.

The commission has issued an order denying the supplemental application of the Marin County Electric Railways for authority to sell stock to other than bona fide residents and property owners of Mill Valley. The commission authorized the company to issue \$67,000 worth of stock but only in the light of promotion enterprise with all the responsibility for loss as gain. The commission will not permit the securities to be sold broadcast to small investors.

TRADE NOTES.

S. Gelher Electric Works, San Francisco, announce two jobs, one at 3322 Fillmore street and one at 1858 Filbert.

The Universal Gas & Electric Company is active, erecting poles in the Richmond and northern Fillmore District, San Francisco.

The Holabird-Reynolds Company of San Francisco have received their Hotpoint electric ranges and had a satisfactory demonstration.

The Schwartz Electrical Company, 750 Clement street, announce a fixture and wiring job at Page and Scott streets, San Francisco.

The Meyers Electric Company, 2014½ Sutter street, has a wiring job for the Geo. W. Brown residence, on Egbert street, San Francisco.

Hetty Bros., San Francisco, are now working on the Christian Science Church at Haight and Ashbury streets and the Episcopal church at Fulton and Fillmore.

The Buzzell Electric Works of San Francisco has just finished a wiring contract for the Mission Masonic Lodge, also a contract of \$2000, wiring the Bemis Bros. Bag Company's building.

The Majestic Electric Development Company of San Francisco is, in spite of the war, making shipments of its products to Europe and Australia. If anything, they say, their business is better since the war began.

Haller-Cunningham Company, 428 Market street, electrical dealers and wireless specialists, recently finished a wireless installation on the steamer "William Chattham," owned by the Loop Lumber Company, San Francisco.

The General Electrical Construction Company, San Francisco, has recently taken the wiring contract for the Moreshead Apartments, California and Mason streets, opposite the Fairmount, as well as that for the Parsonage School and Convent at Twenty-ninth and Church.

Macdonald & Kahn, contracting engineers at San Francisco for the Zellerbach Paper Company, announce a contract for that company in which everything will be electrically driven with entire new equipment. His place covers a space 137 by 300 ft. and is six stories high.

The Great Western Power Company is building a new power substation on Bush street, San Francisco. New offices for the steam department and electric range department have been opened at 511 Sutter street, the former quarters of the United Power Company. The steam department is in charge of Chas. Murphy and the range department in charge of E. A. Wilcox.

Levy Bros., San Francisco, are doing the wiring for the Martini Apartments on Telegraph Hill and six different houses out on Douglass and Jersey streets, San Francisco. The point notable in these contracts is that many of the old homes of San Francisco, which have never been wired, are now being wired on account of the "Wire your home" campaign.

Here is a good one, and he admitted it too: A San Francisco uptown electrical contractor said that a friend of his had a job of wiring to do and opened up the bids showing where one man bid \$155; he had bid \$115, and one of the downtown firms had bid \$90. He said he was favored with the bid for \$115 (because he knew the party) and then when the job was finished he had lost \$60 on the job.

E. L. Byington, San Francisco, electrician, who makes a specialty of colored light and decorations, has just finished two contracts, one for the Bristol Cafe on Fillmore street and the other for the Campus Cafe, 1518 Fillmore street. The last named was contracted for by the Belmont Electric Company, 2238 Fillmore street. V. Fasono, manager of the Belmont Electric Company, is one of the few men who is satisfied with electrical conditions. He said he had all the work he can do and is not losing any money.



NEWS NOTES



ILLUMINATION.

LOVELOCK, NEV.—Plans are underway by which the village will be lighted with electricity.

WINSLOW, ARIZ.—The Winslow Gas Light & Heat Company is preparing to erect a gas plant in Winslow.

SALT LAKE CITY, UTAH.—The contract for lighting the state capitol grounds has been awarded to Eardley Bros., for \$9500.

HUNTINGTON BEACH, CAL.—The city trustees have directed A. R. Lott, manager for the Pacific Light & Power Company, to install eleven new street lights here.

BAKERSFIELD, CAL.—City Manager Morgan after investigating the electrolier lighting system in Fresno, estimates that a similar system could be installed here for \$19,000.

WILMINGTON, CAL.—A petition from the Wilmington Chamber of Commerce, asking for electric lights in the residence district of Wilmington, has been referred by the city council to the board of public works for its attention.

SAN RAFAEL, CAL.—The Pacific Gas & Electric Company of San Rafael has purchased the Richard Hotaling property on the southeast corner of Fourth and E streets as a site for a one story reinforced concrete office building to cost \$24,000.

PASADENA, CAL.—Calling for bids for \$15,000 worth of extra equipment for the municipal light and power plant, the city commission has undertaken to put the plant in the position to supply East Los Angeles and Highland Park with current until the aqueduct plant is completed.

OREGON CITY, ORE.—A special meeting of the city council this month which will be devoted to discussing the practicability of a municipal light and power plant operated by power from the falls is being considered by Mayor Hackett, who urges that the city generate electricity for street lighting and for commercial light and power.

ASHLAND, ORE.—Many customers of the Ashland municipal electric lighting system are planning to install porch lights as a result of action by the city council in offering free current for porch lights to every resident user in Ashland. The Ashland municipal plant has paid a profit since its installation and since the city took over the distribution system of the California-Oregon Power Company in Ashland an additional clear profit of about \$700 a month has been added to revenue from the electrical department. Forty new street lights, 120 decorative lights for the new Hotel Oregon and finally this order of free current for porch lights and the ready response of consumers promise to make Ashland one of the most brilliantly lighted cities in Oregon.

TRANSMISSION.

WALLACE, IDAHO.—Conferences have been held by representatives of the Reindeer-Queen, Carney Copper and Carbonate Hill Mining Companies with a view to the erection of a power plant that will supply electrical energy for the three companies. The Carney Copper is preparing to install a compressor.

SAN FRANCISCO, CAL.—Representatives of telephone, telegraph and electric light and power companies and of other corporations that maintain poles and overhead wires in this city attended a meeting of the board of works a few days ago, at which a joint pole agreement was proposed. An agreement of this character is in effect in Oakland, Los Angeles and other Pacific Coast cities.

PORTLAND, ORE.—The Rasmussen-Grace Company, Bates Building, has received a commission from the Hawley Pulp & Paper Company to prepare the plans and specifications for the 1000 horsepower power plant at the Oregon City

mill. The plant will be situated in the river bed at the falls and will be housed in a structure of reinforced concrete, which will contain a number of unusual features, as at times of high water the plant will be submerged, and must be kept in operation while in this condition.

LOS ANGELES, CAL.—The directors of the San Joaquin Light & Power Company have authorized the expenditure of \$500,000 for the completion of the construction of power house No. 2 in Crane Valley, upon which approximately \$250,000 was expended three years ago up to the time work was held up owing to financial conditions. Tunnels, ditches and the intake have been completed. The power house is located between No. 1 and No. 3 and is a mile and a half south of North Fork. It will utilize the fall of water between the two plants, and develop 3000 kw., as compared with 18,000 kw. developed by power house No. 1 and 2000 developed by power house No. 3.

TELEPHONE AND TELEGRAPH.

SALMON, IDAHO.—The Challis-Pahsimaroi telephone has decided to extend its lines to connect up with the Watkins system.

NEWPORT, WASH.—The Calispell Telephone Association has asked for a franchise to construct telephone lines along the roads in Pend Oreille county.

SAUSALITO, CAL.—A tentative application from the Pacific Telephone & Telegraph Company for a franchise in Sausalito, has been referred to the street committee.

WINNEMUCCA, NEV.—The line of the Utah, Nevada & Idaho Telephone Company is to be extended to Kennedy from the Goldbanks Quicksilver Company in Pleasant Valley.

CLOVIS, N. M.—It has been announced that the new telephone exchange building to be erected here by the Mountain States Telephone Company will cost approximately \$30,000.

NAPA, CAL.—Upon application of Benjamin F. Stetson for a telephone franchise in supervisor districts 2 and 5, the clerk was ordered to advertise for bids, said franchise to be sold on May 10th.

PORTERVILLE, CAL.—Woodville people who want telephone connections with Porterville have taken up the matter with the Pacific Telephone & Telegraph Company, Latimer & Son, who are engaged in building a farmers' line and the Porterville Businessmen's Association.

MARSHFIELD, ORE.—Bids for erecting the proposed government wireless radio station at Marshfield, Ore., will close on May 2. The work involves several small buildings and two wood towers. Plans may be obtained from Navy Pay Office, First National Bank Building, San Francisco.

SANTA BARBARA, CAL.—An ordinance has been adopted consenting to the assignment by the Home Telephone & Telegraph Company of Santa Barbara of a franchise to the Santa Barbara Telephone Company, which was granted to F. F. Graves on August 20, 1903, and was transferred by him on May 10, 1904, to the Home Company.

SALT LAKE, UTAH.—A building for a new telephone plant to serve the suburban districts of Salt Lake City is planned by the Mountain States Telephone & Telegraph Company. The new plant will cost \$200,000 and will be built on a site convenient to both Murray and Midvale. According to the plans of the company the new plant will be completed during this year.

PASCO, WASH.—The Pacific State Telephone Company has taken charge of the local telephone exchange, which was purchased from the Twin City Telephone Company last week for \$12,000. It is the intention of the purchasers to make

many improvements, including a modern switchboard and laying of underground cables. The Twin City Telephone Company has been operated by the Kling Brothers for about ten years. Richard Kling, manager of the old company, will probably move to Montana, where he has property interests in and around Great Falls.

PORTLAND, ORE.—The Home Telephone Company is to pay a \$500 fine and in the future to follow the provisions of the ordinance regulating the installation and maintenance of overhead wires. The decision comes as the result of suggestion by Federal Judge Wolverton that the company and the city attempt to settle their grievances concerning the enforcement of the ordinance. The ordinance was passed in 1909. It specifies how telephone wires and guy wires are to be installed. The ordinance was passed at the instance of the electric linemen and was said to be in the interests of safety. In 1911 the telephone company was fined \$500 by Judge McGinn for alleged violation of the ordinance. The company then took the case to the federal court seeking to enjoin the city in its enforcement of the ordinance. After hearing arguments Judge Wolverton suggested that the case be settled out of court. Officials of the company met with Commissioner Daly and representatives of the linemen's union. Under the arrangements the company is to have 80 per cent of all of its wires installed in conformance with the ordinance within four years, and in cases where real hazardous conditions exist the wires are to be changed within one year. In addition the company is to pay the \$500 fine assessed by Judge McGinn.

TRANSPORTATION

SPOKANE, WASH.—A franchise to operate and maintain street car lines from Thirty-third to Thirty-eighth avenues, on Grand Boulevard, was asked of the city council by the Spokane Traction Company.

SPOKANE, WASH.—The Milwaukee railroad eventually will be run by electricity from Harlowtown, Montana, through Spokane to the coast, as announced by officials of the company. It is stated that the second unit will be completed by fall, and that the third unit will extend to Spokane.

INDEPENDENCE, ORE.—The Southern Pacific Company is making preparations to electrify the lines through this city to Corvallis. The company has asked the city council for a franchise for poles and wiring along the line of the main track on Second street.

SPOKANE, WASH.—An ordinance granting to the Spokane & Inland Empire Railroads Company the right to build, construct, equip, maintain and operate a single or double track electric railway system upon certain streets of the city of Spokane, Wash., is now before the council.

SACRAMENTO, CAL.—A plan of reorganization for the Northern Electric, now in the hands of a receiver, has been agreed upon by a majority of the bondholders, according to C. F. Humphrey, attorney for the latter interest. Following a meeting of the reorganization committee the new plan is to be presented to the new committee for ratification. Details of the plan have not been made public.

WATERWORKS.

PAYETTE, IDAHO.—The commercial club is discussing the proposition of securing an up-to-date filtration system for the city waterworks.

WHITTIER, CAL.—A proposal to issue \$111,000 in bonds for the improvement and development of the municipal water system was defeated at a recent election.

TURLOCK, CAL.—Trustees Weaver and Osborn have been appointed a committee to attend to the matter of preparing plans and specifications for a water plant.

HARLOWTON, MONT.—Bids will be received until April 20 by S. K. Campbell, city clerk, for construction of a municipal water system. Estimated cost is \$25,000.

TWIN FALLS, IDAHO.—The \$80,000 worth of water works bonds have been sold to the Lumberman Trust Company of Portland, Ore., at a premium of \$2488. The money will be used in the development of the system.

WOODLAND, CAL.—An election has been called for May 9th to vote on a bond issue of \$66,000; \$6000 for sewer extensions, \$55,000 for a municipal water plant, and \$10,000 for a municipal ice plant. C. E. Arnold is city engineer.

PALO ALTO, CAL.—The board of public works has adopted plans and specifications for water and sewer main extensions on certain streets that are to be paved and has authorized the advertising for bids to be opened April 17th.

GREAT FALLS, MONT.—Bids will be received until May 16, for the purchase of \$150,000 worth of water bonds, to be issued in denominations of \$1000, bearing 4½ per cent interest, payable in 20 years from date, and redeemable ten years from date.

WOODLAND, CAL.—The city bond election will be held on May 9th. The amount of bonds to be voted on will be \$6000 for sewer, \$55,000 for water and \$10,000 for a municipal ice plant. The bonds will bear 5 per cent interest and will run for 15 years.

TUCUMCARI, N. M.—The electric light company is putting down cement floors and foundations preparatory to installing new machinery for pumping city water. The new machinery and equipment will be capable of pumping about 200,000 gallons per day.

SANTA BARBARA, CAL.—Negotiations for the purchase of the Montecito Valley Water Company by the city for \$20,000 were discussed at a meeting of the water commissioners, city council and owners of the company recently, and it is probable that the matter will be put before the council for formal action shortly.

HEMET, CAL.—Practically four miles of 26 in. main flumes are being replaced by the Lake Hemet Water Company, and the entire system will be thoroughly overhauled. The total cost of repairs to the system is estimated between \$65,000 and \$75,000. A large portion of this expense is made necessary by the change of grade of the flume line.

BOISE, IDAHO.—The state land board has approved the plan to increase from 30,000 to 40,000 acres to be irrigated by the Wichahoney Land & Water Company. The increased cost is also granted from \$750,000 to \$1,256,000. The state engineer reports that the company has sufficient water rights to irrigate more than 40,000 acres. It is expected that work will be started at once on the project.

BILLINGS, MONT.—Bids have been called by the commissioners of Yellowstone county for the digging of wells and installing a water system at Broadview, Mont., and the grading of streets incident to installing the water system. The work includes digging wells, laying water supply lines, building elevated tank, installing pump house and distributing system.

Wanted and For Sale

The rate for advertisements in this column is \$1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue. Replies may be sent in care of the Journal of Electricity, Power and Gas, Crossley Building, San Francisco.

DUTCH INVENTION.—For wood and hardware. Wholesale manufacture. Patented in 12 countries. Can be sold. Apply for particulars to Ingenieurs Bureau, Fr. Eriksson, Rotterdam, Holland.

FOR SALE.—Retiring manager in Electric Light & Power Company, Southern California, will sell interest. Salary \$1500. Few thousand cash will handle. Business prosperous. Address Box 150, Journal of Electricity, Power & Gas, Crossley Bldg., San Francisco.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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PER COPY, 25 CENTS

GROUTING FOR THE KLAMATH RIVER DAM.

BY SIDNEY SPROUT.

MILITARY ENGINEERING.

BY CAPTAIN RICHARD PARK.

FEASIBILITY OF WESTERN ELECTRO-METALLURGY.

BY DORSEY A. LYON AND ROBERT M. KEENEY.

DISCUSSION ON INDUCTIVE INTERFERENCE ORDER.

BY J. C. MARTIN, F. D. NIMS, V. H. GREISER.

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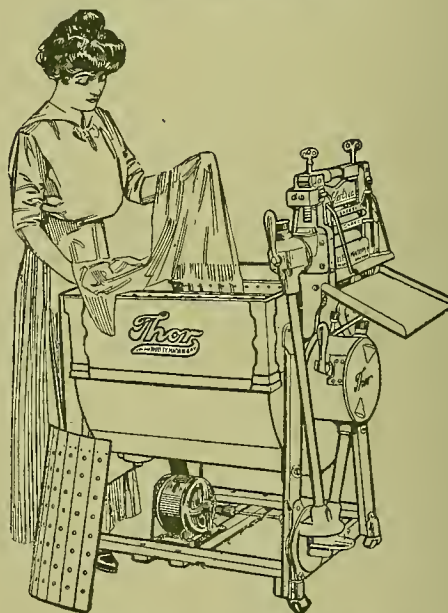
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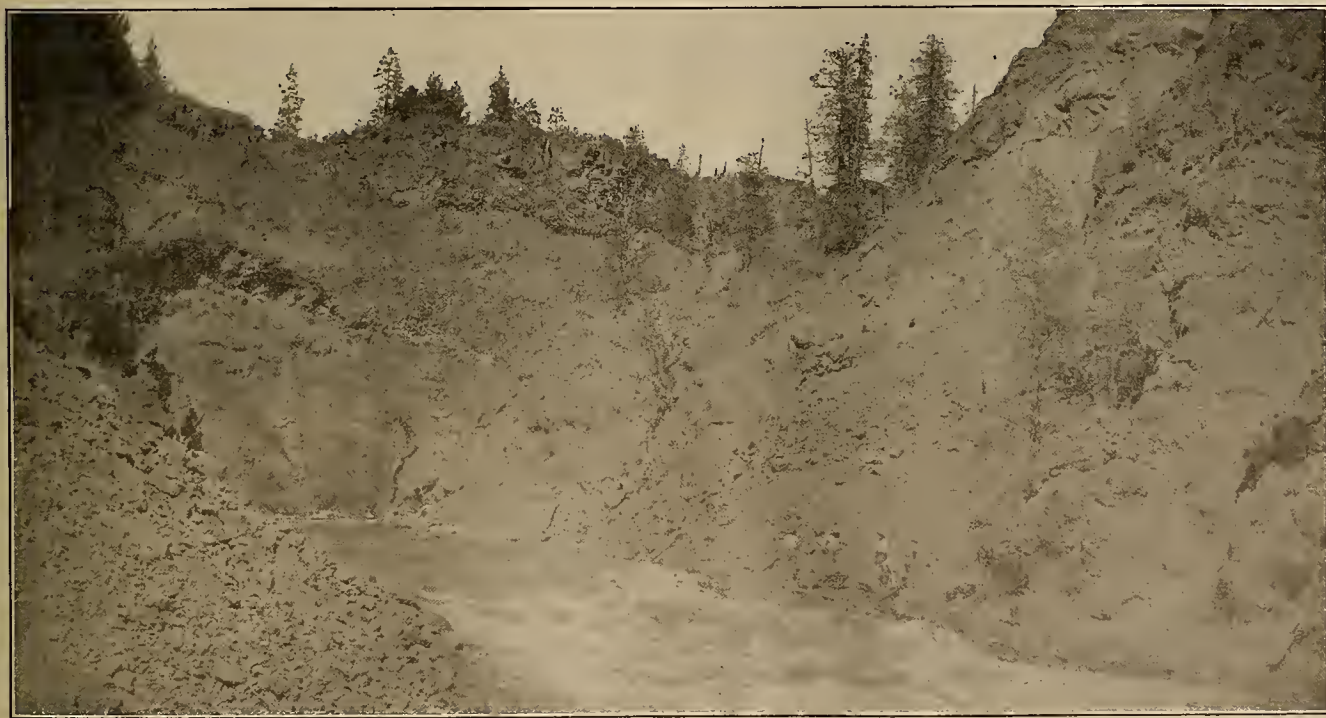
GROUTING FOR THE KLAMATH RIVER DAM

BY SIDNEY SPROUT.

Some unusual conditions encountered in the construction of the Klamath River Dam, now being built by the California-Oregon Power Company, makes a record of interest. After one site had been selected it was found that one of the side walls contained loose rock which would be liable not to hold and so another site was selected as shown in the accompanying illustration. This site showed good walls and apparently

arc of a circle of 356 ft. radius, curvature upstream. The center 200 ft. of the crest will be an overflow section, capable of discharging the highest flood water.

Owing to the position of the highest bed rock of the canyon wall at the dam site, it was found impossible to place the dam diagonally across the river bed. This, however, does not affect the strength of the structure. The total yardage of the dam above foun-



Klamath River Damsite Before Starting Construction.

good foundations and so a wing dam was built to divert the river from its channel into a tunnel on the east side of the river, thus making possible construction operations without interference from the river flow.

The dam is to be of the arch-gravity type designed on the Wegmann principle. It was designed for a height of 130 ft. above the bottom of the river, 90 ft. thick at the base and 13 ft. thick at the top. The base as laid out on the ground, since starting foundation, has been widened to 95 ft. at the assumed bottom. The length of the crest will be 400 ft. curved on the

arc of a circle of 356 ft. radius, curvature upstream. The center 200 ft. of the crest will be an overflow section, capable of discharging the highest flood water.

Diamond Drilling.

Diamond drill borings were made below the level of the river to determine the character of the river bottom. At first these drillings were not considered as giving the true condition of the river bottom. It was fully believed that bed rock would be found not to exceed a depth of 25 ft. below water level. A bed rock was subsequently found at this depth but was a slab about 4.5 ft. thick. The drillings showed a seam

or opening in the river channel running 140 ft. below water level and averaging about 30 ft. wide. This seam was found later in excavating to follow very closely the diamond drill borings.

Total cost of drilling.....	\$4006.42
Total number of feet of holes drilled.....	2400
Cost per foot of hole.....	\$1.67

Grouting Through the Diamond Drill Holes.

In view of the fact that the diamond drill holes which were run in the bottom of the river indicated that the seam in the river bottom was filled with gravel and sand, it was decided to try injecting cement grout through the holes to see if concrete could be made of sufficient stability to keep the gravel in place.

By the means of a cement gun it was hoped to force the cement through a pipe line to the bottom of the diamond drill hole and thence through a special nozzle into the gravel and sand. Air was allowed to run through the pipe all the time to keep the water from coming up from the bottom of the hole into the

barrel until no more could be forced through the diamond drill hole, then a stop cock was shut off at the collar of the hole and the discharge pipe disconnected at the surface of the ground. Clear water was then pumped through the suction hose and pump until all the cement was cleaned out of them. After disconnecting the remainder of the discharge hose and allowing the cement to set for a while the pipe was pulled from the hole and connected to another.

The grouting was first started by connecting with hole No. 17 in which 28 sacks of cement were injected and as far as can be determined the mixture around the lower end of the hole is firmly grouted and concreted together. Hole No. 2 on the same side of the river was then connected up and 69 sacks of cement were injected through it. Some of the cement was observed to come to the surface near the east bank of the river. Very little water came back out of either hole.

The grouting equipment was then moved to the west side of the river and connected with hole No. 15, 37 sacks of cement being injected through it; 30 sacks were injected through hole No. 16; and 23 sacks were injected through hole No. 19. By grouting in these holes all the longitudinal seams between shafts No. 1 and No. 2 were cemented up and the shafts became nearly dry.

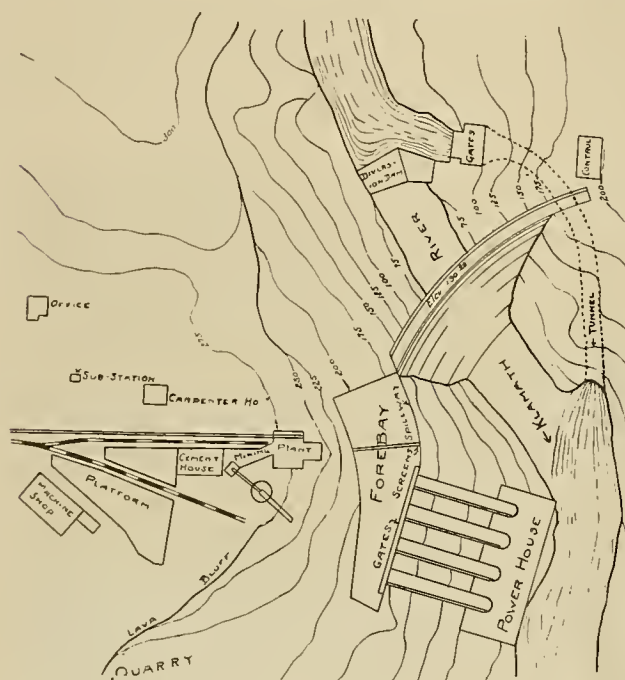
It was intended to place the diamond drill over these grouted holes and drill them out again to determine the extent of the grouting, but owing to temporary shut down of the work, it was impossible to continue. When work was resumed and sinking started, in the river bottom a better form of grouting was found.

Dam Foundation.

In constructing the dam foundation it was decided to provide two curtain walls of grouted material to the full depth, one on the upstream face and one on the downstream face. After this were completed the intervening material was excavated and replaced by concrete.

Work was started on the upstream face first. A crib work was constructed, made up of three cribs, one on each side of the river and a large one spanning the main river channel between them. The cribs on the two sides of the river were afterwards divided into smaller compartments making five cribs in all. Excavation was then started on the east side of the river. The intention was at first to excavate all of the crib but it was found that the rock and gravel on the outer face of the crib leaked so badly that it was impossible to go very deep. A 12 in. pump was installed and bed rock cleaned out to within 4 ft. of the edge. Concrete was then poured to 10 ft. above water level in this crib. In the meantime excavation was started on the west side of the river, carried to bed rock out as far as river edge and filled with concrete to 10 ft. above water level. This made two blocks of concrete, one on the east side of the river and one on the west side of the river, both standing on the river edge and about 90 ft. of river channel between them.

Excavation was then started on the west side of the river adjoining the block of concrete. The plan at first was to carry shafts across the river which would



Map of Klamath River Damsite.

pipe. The first difficulty experienced when the dry cement was allowed to run in with the air, was that the air was too moist and the cement gradually collected on the sides of the discharge pipe until it was clogged. The air line was then heated to dry the air and better results were obtained. The moisture still bothered to some extent and the process was so slow that it was decided to try grout instead of dry cement.

For grouting, a small self-contained 2 in. centrifugal pump and motor was used. A pipe line connected with the diamond drill hole was used as the discharge for the pump, this line being placed far enough into the hole so that it could be calked around the collar of the hole. The suction for the pump was placed in a barrel in which a hose discharged a continuous stream of water, and into which cement was poured continuously and thoroughly stirred. When the pump was started the cement and water was fed into the

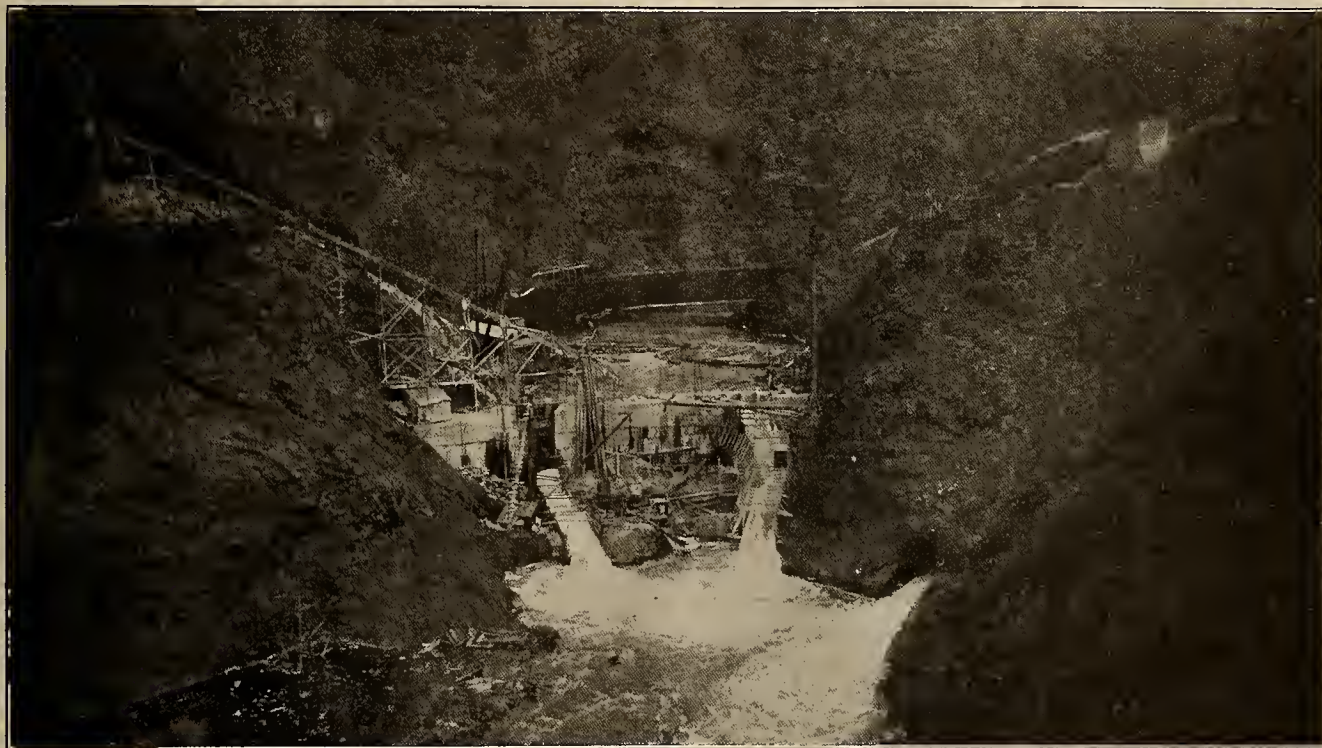
be 20 ft. wide in the direction of the flow of the river. The first compartment taken was 20 by 30 ft. and excavation was started in it. After a few feet of sinking it was found that it would be impossible to handle the water in this size compartment so it was cut in two compartments 20 by 15 ft. The upstream compartment of these two was excavated first and after considerable pump trouble bed rock was found at a depth of 13 ft. The downstream compartment was then finished (10 by 15 ft.) and both compartments filled to water level with concrete.

A spillway, 11 ft. wide, was left through the concrete on water level and just a wall of concrete was carried up on the east side of this spillway. The

cessful. Some of the water was shut off but not enough to make sinking easy.

The plans were then changed and instead of trying to carry a 20 ft. wall across the river it was cut into two 10 ft. walls. The 10 ft. wall on the upper face of the dam was laid off and the first shaft on the west side of the river was started.

Considerable trouble was again found in holding the water so that the men could work but this shaft was sunk under adverse conditions to apparent bed rock at 26 ft. below water level. This shaft was filled with concrete to water level and the next shaft, adjoining it on the east side started. This shaft, known as the northwest compartment of crib No. 3, was the most



View of Foundation Construction.

spillway was connected on the lower side with a 4 by 12 ft. flume 70 ft. long which discharged below the lower toe of the dam and the water which leaked through the wing dam was diverted through it. This left the remainder of the river channel open for excavation.

The river was beginning to raise so a large flume was built in conjunction with the small one and extended from the spillway of the wing dam, across the block of concrete on the east side of the river to about 20 ft. below the downstream toe of the dam. This flume was large enough to hold 3000 second feet.

Having encountered considerable trouble with water up to this time, an attempt was made to grout around the next shaft adjoining the concrete on the west side of the river. This shaft was 10 by 22 ft. A single line of grout pipes was driven around the shaft, spaced 2 ft. centers and driven as deep as possible, some of them penetrating as deep as 26 to 29 ft. After grout was injected through all the pipes and allowed to set for 3 or 4 days, sinking was resumed. It was found that the grouting was not entirely suc-

cessful. As stated above, the grouting was not entirely successful up to this time and the pumps would not handle the water. The material found in the shaft down to 12 ft. below water level was loose rock and below that it was very fine sand, resembling quicksand. Lagging could not be driven close enough to hold the sand with the water running over it. When the sinking had been carried down to 16.5 ft. below water level, work had to be stopped on account of the water and some other method used for holding the water from running into the shaft over the sand.

At this time (Jan. 1, 1914), the river took a sudden raise and overflowed its waste ways, causing considerable delay in the shaft work. On resuming work a pile driver was set up and Wakefield tongue and groove sheet piling driven through the sand in the shaft reaching apparent bed rock at about the same depth as in the preceding shaft (26 ft.) This shaft was then filled with concrete to water level.

In the meantime a successful method of grouting, as later described, was found and the remainder of the

shafts of this wall were sunk without very much trouble.

When the last shaft was sunk near the east wall it was found that at the depth of 26 ft. there was no bed rock and that the preceding blocks of concrete beginning on the west side spillway were not on bed rock, but on a false bed rock at 26 ft. depth. The sinking was stopped at this depth and the shaft filled with concrete in order to protect the finished work from high water.

All of this upstream wall 10 ft. thick was then carried 10 ft. above water level and sinking was started on the downstream half of it, beginning on the west side. Successful grouting made it possible to work on this downstream half of the wall without much trouble from water.

The bed rock wall on the west side was found to drop off about 40 ft. vertically after passing the false bed rock of the upper half of the wall. At 70 ft. below water level, bed rock was found and concrete was poured up to within 35 ft. of water level. A sump was built at this level and water leaking into the shaft was caught up and pumped to the surface.

Two more shafts were sunk to the same depth and joined this one on its east side. Instead of filling with concrete it was decided to finish the excavation of this part of the wall and fill it all at once. When the last shaft was sunk on the east bed rock wall, no bed rock was found at 70 ft. below water level. Sinking was carried on down to 116 ft. below water level before bed rock was found. The east wall was found to follow very closely the diamond drill borings.

The four shafts sunk to bed rock at 70 ft. below water level were then found to be sunk only to a projecting shelf of bed rock joining on the west wall and extending across the river to within 10 ft. of the east wall. As these shafts had not yet been filled, one of them was continued through the shelf of bed rock and all the loose material beneath was removed and the hole filled with concrete. The maximum depth was found in the middle of the channel, 126 ft. below water level.

Bed rock in the bottom of the wall was found to pitch from the lower side of the shafts to about 10 ft. deeper on the upper edge of the shafts. It was somewhat irregular from the effects of erosion but at no place in the bottom was there an indication of a seam. It was expected that when the bottom was reached that a seam would be found continuing deeper, but this was not the case.

Concrete was then poured in all the remaining shafts and carried above water level to the top of the 10 ft. wall and on up so all of the wall was completed to 30 ft. above water level.

The question arose during the filling as to whether or not the material under the false bed rock should be removed. This bed rock, as noted above, was 26 ft. below water level, about 4.5 ft. thick and lay under the upstream half of the wall across the river channel. As the question was undecided, a shaft was left in the downstream half of the wall to a depth of 56 ft. below water level. This shaft is in such a position that the material under the false bed rock can be excavated from it should it be necessary.

The spillway was left through the west side concrete as noted before and an auxiliary spillway was made above it. When the concrete work reached the flume on the east side of the river, the flume was cut and a spillway left through the concrete joining with the downstream half of the flume. This gave spillway capacity sufficient to carry all of the flood water of 1914 and the spring of 1915.

This completed the upstream wall to 30 ft. above water level, which was the same height as the old wing dam and at the same time placed 1/7 of the total yardage of the original proposed dam. The upstream side of this wall was surfaced with cement grout sprayed on with an air cement gun.

During January, 1915, work was started on the lower tow of the dam. Crib work had already been placed across the river and preparations made for sinking a concrete cut-off wall which would shut off any back water from downstream. The wall was laid out on the curve of the downstream toe of the dam, extending 8 ft. thick in the direction of the flow of the river and to be excavated vertically instead of following the slope of the dam.

It was first necessary to do considerable grouting before sinking. Details of this work is shown under grouting.

A shaft was started on the west side of the river, 8 by 16 ft. extending along the proposed wall. This was sunk without difficulty to bed rock. The deepest place in the shaft was 15 ft. below water level, near its east end. Concrete was then poured in the shaft to water level and the small flume on the west side of the river was rebuilt and placed on top of this concrete. The remainder of the wall was then left open and grouting continued across the river on the downstream side of the wall. The width of the wall from the west block of concrete to the east side bed rock was 60 ft.

A shaft was then started on the west side of the river and at the date of this report has been sunk to 75 ft. below water level. The bed rock on the west side was found to follow very closely the diamond drill borings and drops nearly vertically in the full depth sunk at present.

The character of material found in this lower work is very much different from that of the upper wall. In the upper wall after sinking 15 to 25 ft. through loose rock, the material was entirely fine sand and gravel. In the lower wall the material found so far is large washed boulders with some gravel and sand between them. This makes blasting necessary and consequently the work progresses much slower.

Grouting in the River Bottom.

In general, the grouting on the upper wall was carried across the river one shaft at a time, that is, for each shaft sunk, a row of grout pipes was driven around it. When sinking was first started it was found that the upper part of the river bed from 10 to 15 ft. deep was filled with loose rock and gravel with sufficient voids in it to readily admit the water from both upstream and downstream sides. In a shaft 8 by 16 ft. it was found that a 12 in. pump would hardly handle the water which came in through the sides.

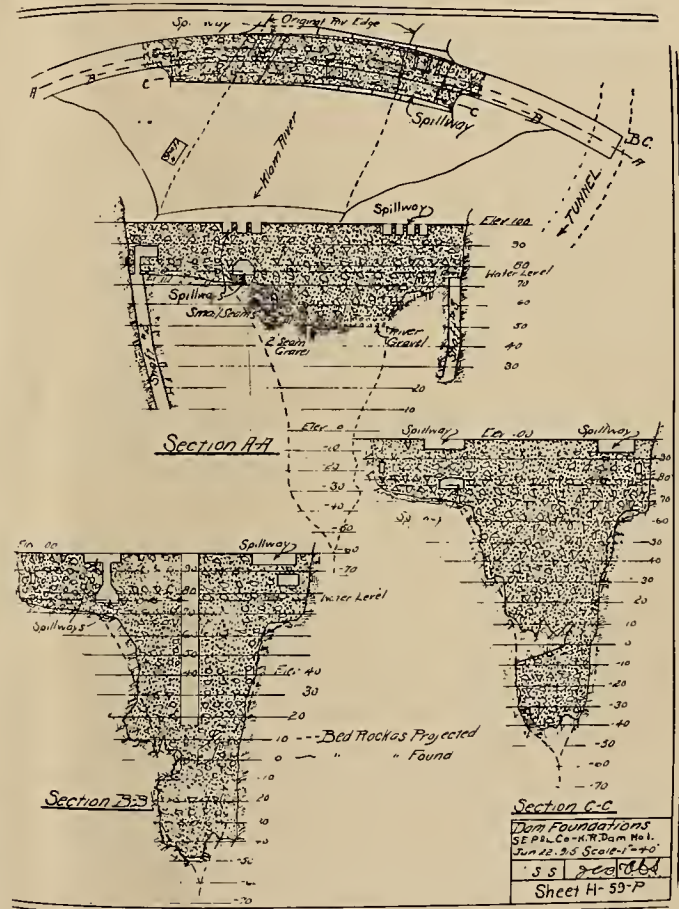
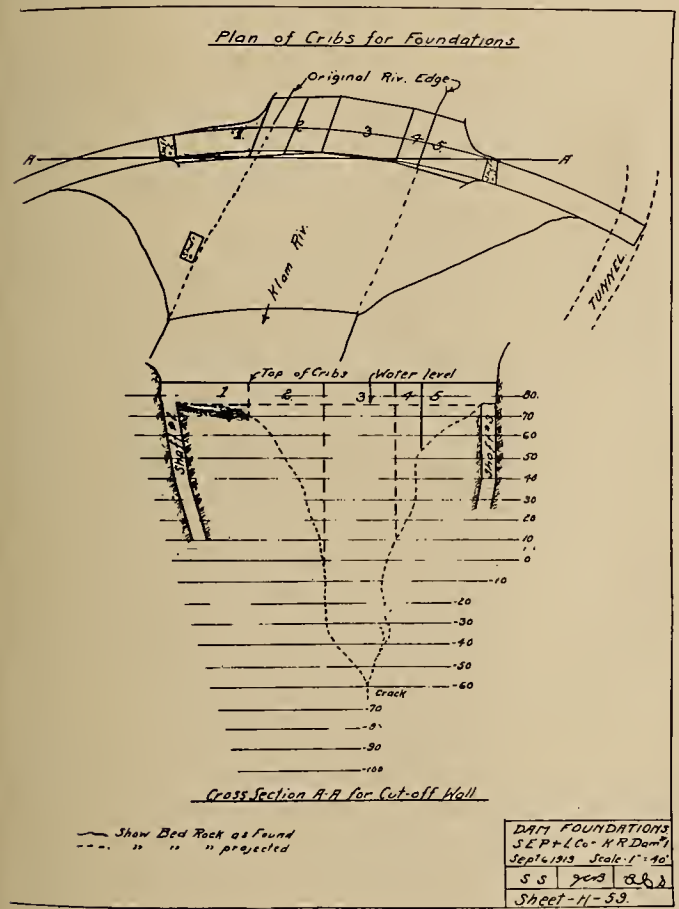
It was practically impossible to sink to any depth with such a quantity of water.

Some means had to be employed to stop the water. Piling could not be driven on account of the rocks and boulders, pneumatic sinking and freezing were too expensive so it was decided to try grouting up the material by filling the voids of the material.

At first the grouting was an experiment. A row of 2 in. pipes was driven around the first shaft on the west side of the river. A barrel set on a platform 60 ft. above the top of the pipes was connected with a 2 in. hose and pipe line to each grout pipe in turn and the cement and sand run through the pipe as they were slowly raised. Some of the holes took as much as 150 sacks of sand and cement but when excavation

Sections of 2 in. pipe were cut to correspond to the drill changes and so that they would leave the drill exposed 3 in. below the lower end of the pipe when the pipe was up against the chuck. When the drill and pipe were in place the machine was started and the pipe was driven with the chuck of the machine at the same time that the drill was making the hole. When the drill was pulled out, the pipe was left in place. A row of these pipes were driven, spaced 2 ft. centers and from 11 to 14 ft. in depth, around the shaft to be excavated.

Whenever a rock was struck the drilling was continued to a reasonable depth, without driving the pipe. The drill was removed and a small charge of powder set off in the hole to break up the rock.



"Before and After" Views of Dam Foundation.

was started it was found that the grouting did not shut off very much of the water. The high pressure of 60 ft. was too much and caused the grout to spread too far away from the hole to raise the surface of the ground.

After some experimenting a satisfactory method of grouting was found as follows:

An air drill was set up on staging vertically above where the row of holes was to be driven. The drill bits were made to pass through a 2 in. black iron pipe and changes were made just the same as in drilling a hole for blasting. At first the drills were made in 2 ft. changes up to 30 ft. in length but it was found that below 15 ft. the material of the river bottom would take no grout, so the length of the drill was cut down to 16 ft.

This row of pipes was then ready to receive the grout.

A 50 gallon barrel was set up on a frame 30 ft. above the top of the pipes. From the bottom of it, a 2 in. pipe extended down and was connected by a short hose with the first grout pipe. At the bottom of the barrel was a 2 in. valve for shutting off the main line, as it was called, and below the valve was a pipe connected with a valve for letting water into the main line under pressure. At the connection on top of the grout pipe there were also two valves for shutting off the main line from the grout pipe and for letting the main line discharge its charge from the side of the pipe.

Cement and sand were dumped into the barrel while water was running into it and stirred constantly

with a pipe stirring rod through which air was passing under pressure.

The grout pipe was then pulled 3 or 4 in. and both main line valves opened. The grout passed from the barrel through the line and grout pipe into the open spaces of the material in the river bed. When the grout began to pass slowly the grout pipe was pulled a few inches and again left standing as long as grout would pass through it. By pulling the grout pipe a few inches at a time, as much as 30 sacks of cement and sand could be forced into a hole and grout could be forced into the material as close as 3 ft. to the surface. Every pipe was treated in the same way and after they were pulled out and were again used for the next row of holes.

After three days setting for the grout in the first row of pipe a second row was driven. The pipes in the second row were staggered with those of the first and the rows were only 2 ft. apart.

The second row of holes would not take as much grout as the first but from the table it will be seen that there still remained considerable voids in the material close to the first row of holes.

After the second grouting was allowed to set for 7 days, sinking was started and it was found that in shafts where a 12 in. pump would not handle the water a 4 in. pump would easily handle it.

The grout wall was found to stand well without timbering and in some places was 10 ft. thick. The grout spread on an average of three feet on each side of the grout pipe and proved to be very satisfactory filling for the voids in the river material.

A portable telephone, made of aluminum and weighing 2½ pounds, the invention of a forest officer, R. B. Adams of Missoula, Montana, will be part of the regular equipment of patrolmen on the National Forests the coming field season. This instrument is regarded as a great improvement over the set formerly used, which weighed ten pounds. A field man equipped with this telephone, a few yards of light emergency wire, and a short piece of heavy wire to make the ground connection can cut in anywhere along the more than 20,000 miles of Forest Service telephone lines and get in touch with the headquarters of a supervisor or district ranger. To talk, one end of the emergency wire is thrown over the telephone line, the two ends are connected to the portable instrument, and the instrument is connected to the ground wire, the end of which must be thrust into the damp earth or in water. Contact with the line wire is made possible by removal of the insulation from a few inches of the emergency wire.

The Adams instrument does not ring the bell of the receiving telephone, but instead causes a screeching sound from a small megaphone-shaped apparatus known as a "howler." This instrument is installed at the ranger station telephone and is said to give effective notice that some one is on the wire. If the field man needs to talk with some one elsewhere on the line, the ranger station instrument can be used to ring up the person wanted, when the conversation can be carried on.

MILITARY ENGINEERING.

BY CAPTAIN RICHARD PARK,
Corps of Engineers, U. S. Army.

(Continued.)

Construction and Destruction of Obstacles.

In addition to the duties of the engineers in connection with location and construction of field intrenchments, they are charged with the construction of obstacles calculated to impede the advance of the enemy in an attack, with the mining operations in underground warfare, with the demolition of any facilities or devices which will assist the enemy, or of obstacles that will impede the operations of their own forces, and with the construction and operation of field searchlights, flares, and other devices for illuminating by night the enemy's works, and the approaches to their own works.

The object of obstacles is to protect works from surprise, to reduce the momentum of attack breaking up the enemy's formation, and holding him under the accurate fire of the defense. They should be invisible from the direction of approach, difficult to destroy and should afford no screen or cover to the enemy.

The form of obstacle most commonly used consists of a barbed wire entanglement made by stringing barbed wire loosely between poles firmly driven into the ground. The wire must be securely nailed to the pole, and every measure taken to anchor the entanglement as a whole to the ground so that it can not be readily uprooted. Previous to the war, text books taught us that wire entanglements should be from 50 to 100 yards in advance of the firing trenches. They are being employed in front of the European trenches at distances between 20 and 50 yards in front of the works. They should be at least 30 ft. wide to be effective. A portable wire entanglement can be constructed by nailing strips of wood in the form of crosses along a straight timber, and stringing barbed wire between the cross arms.

Other obstacles are made by felling trees toward the enemy, leaving them attached to their stumps, cleaning out the foliage and small branches, sharpening the large branches pointed toward the enemy. Land mines consist of small charges of dynamite buried a foot or two beneath the surface of the ground and electrically discharged during the passage of troops amongst them. While but little actual damage is caused to troops by these, their moral effect when fired is very great. Backing up the water of a stream so that it overflows a considerable area forms a good obstacle even though it can be forded. The difficulty of fording can be increased by first constructing low wire entanglements in the area to be flooded. To accomplish such work of course the dam-site must be within the defenders' lines or thoroughly protected by its artillery.

Other forms of obstacles are in common use in the present war, such as planks full of spikes, points turned upward, scattered amongst the barbed wire entanglements, crow's feet or many sided iron crosses whose arms are sharp pointed and so arranged that two or more of them will always point up. Military pits with sharpened stakes projecting upwards at the bottom, used to be very effective, but nowadays the artil-

lery can easily destroy these, using high explosives. Electricity is made use in a most effective way in the first stages of an assault. Wires are concealed amongst the barbed wire entanglements and the circuits given a high voltage charge. The ground forms part of the circuit so that when the advance troops come in contact with the live wire many of them are electrocuted. This is an effective means to prevent surprise attacks, but when the assault is preceded by an artillery bombardment, the wires of the electric circuits are usually broken. Another modern obstacle is poisonous gas, used also in the attack, pipes or receptacles filled with chlorine gas are concealed in the foreground of a position, and the gas is permitted to escape at the moment of attack.

Besides his duties in connection with the construction of obstacles, the military engineer is charged with the destruction or demolition of any facilities or devices that will assist the enemy or impede the progress of his own troops. Before an infantry attack can be launched with any chance of success, against an intrenched position protected by barbed wire entanglements, it is absolutely essential that passages be first cut through. In the Russo-Japanese war the engineers were detailed to precede the infantry line and cut passages through the wire entanglements and other obstacles. In the attack on one of the Laioyang defenses, eighty engineers cut the wire entanglement and engaged the Russians hand to hand. Only ten of them were unhurt. In the present war it would seem that the artillery high explosive shell is being used effectively in leveling obstacles, in preparation for the infantry assault.

One of the important requirements of a fortified position is a clear field of fire for some distance in front of the firing trenches. Formerly we were taught that the foreground should be cleared to the effective range of the small arm—at least 1000 yards. No attempt is being made in the present war to clear the foreground for a distance greater than 300 or 400 yd., and a field of fire of 100 yd. is regarded as satisfactory if it cannot be increased without loss of concealment. It is the duty of the military engineers to provide for the clearing of the foreground of trees, brush, hedges, buildings, walls, growing crops and other cover that would be of use to the enemy, including the filling in of depressions or sunken roads. Wooden buildings, hay stacks and other inflammable objects can be destroyed by fire. Other structures can be dynamited. Crops that would afford protection such as sugar cane or corn must be cut or dragged.

A most important phase of demolition work is the destruction of transportation and supply facilities in rear of a retreating army, in order to prevent unhindered pursuit by the enemy. This work entails the destruction by fire or explosives of bridges and culverts, the sinking, burning or carrying off of boats, blocking tunnels, destruction of railroads, railroad buildings, and rolling stock, cutting telephone or telegraph lines, blowing up highways at critical points, destruction of abandoned defensive works, ammunition plants and arsenals. The duty of the engineers of the pursuing army is of course the hasty reconstruction of all of these features necessary for further ad-

vance. For this work of demolition our engineer troops are equipped with what is known as a demolition outfit consisting of the necessary tools, explosives and transportation.

Military mining consists in the sinking of shafts and driving tunnels to points under or in the vicinity of hostile works, the excavation of chambers or pockets at the extremities of the tunnels, the placing therein of explosives and the firing of the charges. The object of the explosion is either the destruction of hostile works or the formation of great holes or craters near or within the enemies' lines which can be occupied and held by the attack. The primary requisites for subterranean excavations are accuracy of direction, preventing of caving, ventilation, drainage and lighting. In former wars mining was generally confined to siege operations. In the trench warfare of the present conflict hardly a day goes by but what the newspapers report the explosion of a mine with resultant loss of life, and the occupation of the crater by one side or the other. There is always danger that counter mines of the enemy will be met and then the side which can get its mine charged and fired first is the winner for the time being. Sometimes hostile mines run by or overlap each other, and it is possible for one side to locate the tunnel of the other by means of listener galleries, which are small side tunnels dug very quietly toward the sound of talking or toward the noise made by the picks and shovels in the hostile gallery. Such galleries are enlarged into mine chambers at proper distance from the enemy gallery, charged and fired, with the resulting destruction of the gallery and the enemy miners at work therein.

The military engineers' duties in the construction of obstacles, in demolition work, and in mining operations, absolutely require that the men who perform them shall have had prior experience and training along these lines. In the employment of inundations for obstacles the hydraulic engineer is needed. The engineer officer must be enough of an electrician to know how to string his wires and insulate them amongst the barbed wire entanglements and how to get and operate a source of electric power. He must be an expert in the handling of explosives so that if he is ordered to destroy a great railway steel truss bridge, he will know what are the members most vulnerable to attack, and further the amount of explosive necessary to destroy such members. The engineering features involved in mining work are perhaps the most complicated. It takes considerable skill to sink a shaft under fire, properly timber it, break out a tunnel or gallery from the bottom, drain and ventilate it, and dig it so that its head will reach a previously designated point at a definite depth below the ground some hundred yards away, especially when you consider that the cross section of such galleries is usually quite small. The officer in charge of the mining operations must know the quantity of explosives necessary to form the sized crater that is ordered, or to destroy the enemies' works, proper allowance being made for the distances between mine and objective, both vertically and horizontally, and for the character of soil, whether it be clay, sand, hardpan or what.

(To be continued.)

FEASIBILITY OF WESTERN ELECTRO-METALLURGY.

BY DORSEY A. LYON AND ROBERT M. KEENEY.

(Continued.)

Ferro-alloys.

Ferro-alloys are manufactured by reduction of ores with carbon or some other reducing agent such as silicon or aluminum in the electric furnace. In ferro-alloy manufacture the electric current is used simply for the heat contained, and not to cause electrolysis, and so an alternating current is preferable to direct current for this purpose. The advantage which the electric furnace has over the combustion furnace in the manufacture of ferro-alloys is due to the fact that many refractory oxides which cannot be reduced to metals at the temperature of the combustion furnace are easily reduced at the higher temperature of the electric furnace.

As the purpose of this report is an inquiry into the possible market for power in the electro-metallurgical industry, we will consider the possibility of manufacture at The Dalles of only those ferro-alloys which are manufactured today by the electric furnace process in sufficient quantities to be large consumers of power. The ferro-alloy most used in the steel industry is ferro-manganese. To date, however, it has not been successfully manufactured in the electric furnace on a very large scale as compared with blast furnace ferromanganese, largely because of the cost of production in the electric furnace. Ferrosilicon and ferrochrome are made in the electric furnace in such large quantities as to be large consumers of power. There are several other ferro-alloys made almost entirely in the electric furnace such as ferrotitanium, ferrotungsten and ferrovanadium, but the power consumed by each is so small that they are not especially important as power consumers. A plant manufacturing ferrosilicon and ferrochrome could make these alloys.

Ferrosilicon—Raw material and labor. The raw materials necessary for the manufacture of ferrosilicon in the electric furnace may consist of wrought iron, cast iron or steel turnings or iron ore, quartz or sand, and charcoal, coal or coke. The choice of the source of iron depends chiefly on the cost of the material. Iron in form of turnings is more commonly used than iron ore, because the power consumption is lower. Some manufacturers also claim that the operation of a furnace on iron turnings is more steady than on iron ore.

For supplying silicon in the charge, quartzite is preferable to sand because it is more pure, and thus does not form as much slag to clog up the furnace. The quartzite is usually crushed to about 2 in. or less in size.

The use of charcoal, coke or coal depends largely upon the cost of these materials. As the material is used only as a reducing agent and as no strength is necessary to support the charge, due to the absence of a shaft in a ferrosilicon furnace, the cheapest and purest reducing material available is used.

While it has been estimated that from 60 to 100 tons of iron and steel borings or turnings are produced per month in Portland, we believe that iron ore would be the most satisfactory and cheap form of iron for the manufacture of ferrosilicon. The supply of borings and turnings would probably prove unsteady, due to

the fact that it is coming from one town, or perhaps from Seattle or San Francisco, which would raise the cost. It is not possible to purchase from another nearby source, as there is no other local source. The cost of iron or steel turnings at The Dalles would be in the neighborhood of \$6 to \$8 per ton. About 1200 lb. of this scrap iron would be necessary per long ton of ferrosilicon, costing at The Dalles from \$3.24 to \$4.21. This price would fluctuate considerably depending upon the demand for scrap iron. If an electric furnace steel plant were also located at The Dalles, there probably would not be enough turnings for both, as it is a convenient form of scrap metal to use in electric steel manufacture. The steel plant would then get all the turnings, as it could afford to pay over twice as much for them as the ferro-alloy plant. It has been estimated that Chinese iron ore containing 60 per cent iron can be laid down at The Dalles at a cost not exceeding \$5.00 per ton. About one ton of this iron ore would be required per ton of ferro-silicon manufactured containing 50 per cent silicon.

The most available deposit of siliceous material near The Dalles is a bed of diatomaceous earth located two or three miles south of The Dalles. This material analyses:

SiO ₂	82.70 per cent
Loss on ignition.....	11.07 per cent
Fe ₂ O ₃	2.90 per cent
Al ₂ O ₃	3.20 per cent
Total	99.87 per cent

While this material is not very high in silica, it contains no very harmful impurities, as 11.07 per cent of them are lost on ignition. One disadvantage to the use of this material in the electric furnace lies in its powdery form, as there would be a high dust loss. The cost of this material at the plant should not exceed \$2 per ton. Owing to the possibility of high dust loss, it is probable that two tons of siliceous material would be required per ton of 50 per cent ferrosilicon produced, costing \$4.

Charcoal would be the most satisfactory form of carbon to use for a reducing agent in the manufacture of ferrosilicon at The Dalles, both on account of its cheapness as compared with coke and greater purity. While it has been stated that it would be produced for \$8, we will use \$9 per short ton as the cost of charcoal at The Dalles. Coke would cost at least \$10 and cause more slag in the furnace because of its ash than would be the case with charcoal. Labor requirements in the manufacture of ferrosilicon are the same as in aluminum manufacture.

Power. A ferrosilicon plant requires alternating current at a voltage of from 40 to 100 volts, the larger the furnace the higher the voltage necessary. Transformers would be used to lower the voltage from 11,000 volts to 40 to 100 volts. Allowing for a 5 per cent loss of energy in the transformation and for line loss to the furnace, the cost of power per horsepower year delivered at the furnace would be \$10.52 per horsepower year. On the basis of a 90 per cent load factor the cost of power at the furnace would be \$11.70 per horsepower year, or 0.18 cents per kilowatt hour.

Cost of production. Our estimate of cost of production of ferrosilicon at The Dalles is based upon a plant consuming 5000 horsepower in production of

about 3200 tons of 50 per cent ferrosilicon per year, which would be equal to a good sized European plant.

Cost of Production of 50 per cent Ferrosilicon per ton (2240 lb.)

1 ton of iron ore at \$5.00 per long ton.....	\$ 5.00
2 tons of siliceous material at \$2.00 per long ton.....	4.00
1500 lb. of charcoal at \$9.00 per ton.....	6.75
50 lb. of electrodes at 5 cents per lb.....	2.50
9700 kw.-hr. at 0.18 cents per kw.-hr.....	17.46
Labor.....	12.00
Repairs and maintenance.....	5.00
Amortization, depreciation at 5 cents each.....	2.00
Interest at 6 per cent.....	1.20
General and packing.....	4.00

Total\$59.91
per long ton

In round numbers we estimate the cost of producing ferrosilicon containing 50 per cent silicon to be \$60 per long ton. The cost of this material laid down in Pittsburgh, the principal market would be about \$70 per ton. To this freight charge should be added \$3.50 for selling expenses, making the total cost f.o.b. Pittsburgh \$73.50 per long ton.

Market. Practically all ferrosilicon containing about 50 per cent silicon or more is sold through Pittsburgh, New York or Philadelphia. Pittsburgh is the chief market. The price of the 50 per cent grade has varied for the past two years from \$70 to \$75 per long ton f.o.b. Pittsburgh. A company to be certain of success would have to be able to produce the alloy laid down in Pittsburgh at a cost considerably under \$70 per ton, say \$60 per ton. Hence it is evident that ferrosilicon manufactured at The Dalles for \$73.50 per ton f.o.b. Pittsburgh would not stand much chance of being sold at any profit.

It is difficult to estimate the consumption of electric furnace ferrosilicon in the United States, but it is between 10,000 and 15,000 tons. Of this 9257 long tons were imported during the year ending June 30, 1914. The duty during this importation was 20 per cent ad valorem, but it is now reduced to 15 per cent ad valorem. It is difficult to estimate the production in the United States. There is a market for ferrosilicon in the United States, but financial success requires a lower cost of production than our estimate shows.

Conclusion. We are of the opinion that the manufacture of ferrosilicon at The Dalles would not prove to be a profitable enterprise, because we do not believe that the alloy can be produced at a low enough cost to compete successfully with foreign ferrosilicon, which can be laid down very cheaply in the United States. Foreign ferrosilicon includes that manufactured by the Canadian plant at Welland, Ontario.

We base this conclusion almost entirely upon the estimate that ferrosilicon manufactured at The Dalles could not be sold f.o.b. Pittsburgh at less than \$73.50 per ton without losing money. The high cost of manufacture at The Dalles is caused by the cost of reducing material, siliceous material and labor. To this must be added a high freight rate upon the finished product. Market conditions are excellent for the sale of domestic ferrosilicon, but it must be produced at about \$60 per ton f.o.b. Pittsburgh. A 5000 horsepower plant would manufacture about 3200 tons of ferrosilicon per annum, which would be about one-third of the present imports. However, although a good market exists for the sale of this product, we do not believe the manufacture of ferrosilicon at The Dalles would be successful financially.

Ferrochrome—Raw materials and labor. The raw materials essential for the manufacture of ferrochrome are chromite and charcoal, coal or coke. For reducing material charcoal would be the best to employ at The Dalles for the reasons stated in the discussion of ferrosilicon. About one quarter of a ton of charcoal costing \$2.25 is required per ton of ferrochrome. The raw materials should be of the highest purity possible. Foreign manufacturers use only chromite containing less than 0.1 per cent phosphorus and sulphur and about 50 per cent Cr_2O_3 . They use no lime in the charge, as it has been found preferable to use pure materials and keep the amount of slag as low as possible.

The most available source of chromite for use at The Dalles would be California chromite. An analysis of California chromite is as follows:

Cr_2O_3	52.65 per cent
FeO	15.30 per cent
Al_2O_3	11.40 per cent
MgO	16.32 per cent
SiO_2	3.40 per cent

This ore can be purchased in San Francisco at from \$12 to \$15 per short ton, and could be laid down at The Dalles at a maximum cost of \$18 per ton. One and one-half tons of chromite costing \$27 are required per ton of ferrochrome produced. Labor requirements are the same as in aluminum and ferrosilicon manufacture.

Power. The same power equipment as regards transformers would serve for a ferrochrome furnace as for a ferrosilicon furnace, and the cost of electric power at the furnace will be taken at the same, \$11.70 per horsepower year or 0.18 cents per kilowatt hour.

Cost of production. In estimating the cost of production of ferrochrome at The Dalles, we assume a plant capacity of 3000 horsepower producing 2500 tons of ferrochrome per year. The ferrochrome is to contain 60 per cent chromium and 8 to 10 per cent carbon.

Cost of Production of Ferrosilicon per ton (2000 lb.) at The Dalles.

1½ tons of chromite at \$18 per ton.....	\$27.00
500 lb. of charcoal at \$9.00 per ton.....	2.25
40 lb. of carbon electrodes at 5 cents per lb.....	2.00
6335 kilowatt hours at 0.18 cents.....	11.70
Labor.....	15.00
Repairs.....	4.00
Amortization, depreciation at 5 per cent each.....	2.50
Interest at 5 per cent.....	1.50
General and packing.....	4.00

Total\$69.95
per ton

We estimate the cost of producing ferrochrome containing 60 per cent chromium and 8 to 10 per cent carbon to be about \$70 per ton. The cost of this material f.o.b. Pittsburgh, the principal market, would be \$80 per ton. To this there should be added \$5 for selling expenses, making the total cost f.o.b. Pittsburgh \$85 per ton.

Market. The consumption of ferrochrome in the United States has been as high as 8000 tons per year, practically all of which except 500 to 1000 tons is manufactured in the United States. So it is evident that the present domestic production practically supplies the consumption. The 8 to 10 per cent carbon ferrochrome sells for from \$100 to \$130 f.o.b. Pittsburgh. The duty on this grade is 15 per cent ad valorem.

Conclusions. Ferrochrome could be manufactured at The Dalles and laid down sold in Pittsburgh at a profit of \$15 per short ton, but there would be such

strong domestic competition in the sale of the product that the success of a company making this alloy would depend entirely upon the sales department. The production of 8000 tons per annum would not require over 10,000 horsepower, and with the market crowded as it is we do not believe it would be safe to start with a plant capacity of over 1000 horsepower producing about 800 tons per annum. If this was successful, the capacity could be gradually increased. Of course the cost of production with a smaller plant would be a little larger than the estimated cost. The ultimate capacity of a successful plant would not probably exceed 3000 horsepower.

(To be continued.)

PHOTOMETRY OF THE GAS-FILLED LAMP.

The new high efficiency gas-filled lamp introduces variables not hitherto encountered in the photometry of incandescent electric lamps. On account of the comparative broadness of the filament spiral and the dissymmetry of the filament mounting, there is considerable irregularity in the distribution of the light about the vertical axis. Consequently, when the lamp is rotated, as is commonly done in rating lamps at the factory, the light as seen in the photometer flickers so excessively as to render accurate measurements of candlepower practically impossible without the use of auxiliary apparatus. However, as is sometimes done, if two mirrors inclined to each other be placed back of the lamp, the flickering is so much reduced as to permit accurate candlepower measurements even at very low speeds of rotation.

But this expedient does not eliminate the most serious trouble caused by rotation. It was found that at constant voltage both the current consumed and the candlepower are different when the lamp is rotating than when it is stationary, the current changing in one direction and the candlepower always in the opposite direction; that is, there is a change in the operating efficiency of the lamp. Furthermore, this change in efficiency may be either positive or negative, depending upon the speed, and it is about twice as great when the lamp is rotating tip up as when it is rotating tip down.

Fortunately, from the standpoint of photometry, there is for each lamp in either position a particular speed at which the current and the candlepower have the same values, respectively, as when the lamp is stationary. Hence, with the lamp rotating at this speed its candlepower can be measured with accuracy in spite of its rotation. The speed for the above condition is practically the same for all lamps having the same number of loops in the filament; but for lamps having different forms of filament mounting it varies from lamp to lamp, being greatest for those having the smallest number of loops in the filament.

If the above precaution as to speed adjustment is not observed and lamps are rated while rotating at speeds ordinarily used in photometering vacuum lamps, the errors which enter may amount to as much as 1 to 2 per cent in current, or watts, in one direction, and as much as 15 to 20 per cent in candlepower in the opposite direction. Hence the voltage found for a desired operating efficiency may be so much in error

as to give a lamp on test at this rated voltage a fictitious life value three or four times as large as the lamp would give if it were operated stationary at a voltage corresponding to that efficiency which during the rating was only apparent. That is, the lamp may be given credit for a much longer life than it really deserves. On the other hand, the speed may be such as to cause errors in the opposite direction resulting in a lamp life much shorter than would be expected from the apparent efficiency rating.

Another peculiarity of the gas-filled lamp is that while it burns the blackening occurs, not all over the bulb in approximate proportion to the light distribution as in the vacuum lamp, but principally at the top of the bulb because the volatilized material is carried upward by the gas. Hence in making a life test a true measure of the reduction in total light during the life of the lamp can not be obtained, in the usual manner, by mean horizontal candlepower measurements, but by determinations of the total flux or mean spherical candlepower. This is accomplished most rapidly and conveniently by means of an integrating photometer, such as the Ulbricht sphere, in which the lamp is measured stationary, and thus all the complications arising from rotation are entirely avoided.

As to the cause of the variations observed in candlepower and efficiency when the lamp is rotated, it is concluded from the results of a number of special tests that the whole effect is produced by a change in the convection currents of the gas, a consequent variation in the temperature distribution in the bulb, resulting in a change in the resistance, and therefore a variation in the current and candlepower of the lamp. —Scientific Paper No. 264 U. S. Bureau of Standards.

A field water purification plant of the ultra-violet-ray sterilization type was recently designed and installed by Captain F. A. Dallyn to provide a better water supply for Canadian troops in camp. As described in the Canadian Engineer, polluted water is pumped from the Niagara River through a mechanical filter of the reverse-flow type, mounted on a four-wheeled wagon. From this it goes to the sterilizing apparatus, passing through three quartz tubes, to each of which is attached an ultra-violet-ray lamp, the emanation reaching the water through the quartz. The tubes, 4 in. long by $1\frac{1}{2}$ in. diameter, are carried in a casting, and water-tight joints are secured by means of rubber gaskets. Three windows are provided in the casting, through which the operator can watch the lamps, etc. The outfit includes a Westinghouse generator, engine, and Albany pump. Current is supplied by a $2\frac{1}{2}$ kw. 220-volt direct-current dynamo; the pump is a $2\frac{1}{2}$ in. water-sealed rotary type machine, with a capacity of 3000 gallons at 250 r.p.m. These are driven by a 9 h.p. Lister vertical petrol engine, fitted with automatic pump lubrication, enabling it to run between 200 and 250 hours without refilling the oil chamber, pump-fed carburettor, etc. It has reduced the normal count in raw water of 4000 bacteria per c.c. to from 10 to zero. Colon bacilli were commonly present in 0.01 c.c., but after sterilization were normally absent in 50 c.c.

SOME PROBLEMS OF INDUCTIVE INTERFERENCE.

(This discussion on the paper of this title published in these columns April 15, 1916, was held at a joint meeting of the Portland A. I. E. E. and N. E. L. A. Sections, Jan. 11, 1916. The remarks are confined primarily to criticizing the inductive interference order of the California Railroad Commission. —The Editor.)

J. C. Martin: To those not familiar with conditions in California, the first impression is that the order places in the hands of the telephone interests, the power to dictate almost anything they choose in the construction of paralleling power lines and their connected apparatus. Naturally, that excites a power man. We have felt that the order is tentative.

Referring to the letter of transmittal, we note that the committee itself makes such a statement, and furthermore, in the discussion of the report, the statement is repeated. The feeling of the power men has been that until a more definite knowledge of the problem involved and satisfactory means of remedying the troubles are obtained, it is not advisable for any state outside of California to adopt such an order. The thing we have looked at is the order. Without any definite knowledge of California conditions, it has been interpreted by power men simply as it reads.

So far as we of the Northwest are concerned, (speaking for myself and for the committee of the Northwest Electric Light & Power Association as a whole) we are ready to meet any of the telephone representatives on any cases of trouble they may have. We are willing to discuss the matter, and reach any settlement that we can see is reasonable and involves mutual responsibility.

There has been considerable comment upon the fact that the California order contains nothing that indicates any great amount of investigation on the part of the committee as to what could be done on the telephone plant or its equipment to remedy troubles claimed to exist. I don't know what has been done, though I understand that what has been done has been done largely by the telephone interests. They state that they have gone very fully into the question but have failed to find any means of solving the problem. The feeling of power engineers is that there should be a much more thorough investigation made of this phase of the subject and that the investigation could be carried much further than it has been in California if some independent investigating body that would be free from any suspicion of bias one way or the other could take hold of the work. It is a subject that few or none of the power men know anything about. I presume that further study will reveal that what has been done so far has only scratched the surface.

One feature that Mr. Griswold has touched upon that we consider of extreme importance is the economic feature. Both industries must assume a fair share of the burden. The public, in the end, must pay for the cost of solving the problem, and it must be solved on the basis which will render the greatest benefit to the public at the least cost. In other words, nothing can be done that will allow the extension of one service to a community to the partial or complete exclusion of the other.

J. B. Fiske: There is very little in the paper that offers a subject for discussion. We all agree with Mr. Mastick in what he has stated, and if there is going to be any discussion at all, it seems to me the only problem we have is the California order. The California order, as we are told, is very satisfactory, and is working out very nicely in California. If that is so, I have no doubt the California conditions must be very different from the conditions in the Northwest, because it would not work out at all with us.

Up to about twenty years ago the tendency as regards the building of cities was to locate them where coal mines were, or immediately at water falls, so that cheap power could be had. But nowadays, since the development of the multi-

phase system of electric transmission, other considerations enter into the locations of towns. Twenty years ago the miner was under the necessary of developing power with coal, or some other fuel, but on the Pacific Coast today, and indeed almost all over the United States, he is furnished with cheap electricity. Twenty years ago irrigation was almost unknown except where a gravity system could be had. Today on the desert, which not so very long ago was the home of rattlesnakes and jackrabbits, we have a veritable garden of Eden. All these changes are due to cheap electrical power. The people, generally, have benefitted from this transformation, and the telephone interests have, undoubtedly, benefitted also. It would be a mistake economically to do anything that would tend to destroy the power industry or to unnecessarily retard it, and a study of the California order will show, I think, that in many cases, the growth of the power industry would be seriously impaired if we had an order such as this to work under.

A great deal can be done by co-operation. We, in Spokane, have endeavored to co-operate as far as we possibly can. We have not spared expense where in our opinion it was necessary to protect the telephone company's service. I might cite the case of one line we built a year or two ago, where we went to very considerable expense in order to avoid building along the same road that was already occupied by a telephone toll line. It increased the expense of that part of our construction about twenty-five hundred dollars. At one place we had to buy a right-of-way for three miles through rock piles, where almost every pole hole had to be blasted. We had also to build a road in order that we might get the material in. That is only one case but there are others, and we have in every way possible endeavored to keep from injuring the telephone interests. In another case it was with the same idea of not injuring the telephone interests by interfering with their line that we located a new line as far away as possible from the telephone toll line. It necessitated buying easements for miles. It necessitated a clearing of heavy timber, and we did all that and built the line. It wasn't very long before the telephone company cast its eyes on that beautiful straight clearing, and they abandoned the line along the road and built a new line on our right-of-way which paralleled our line for several miles.

Under the California order, if it applied in Idaho, the telephone company could require us to rebuild our line. That does not strike us as being fair. We were there first and went to the expense of making the clearing, and then to have them come in and require us to rebuild our line would strike any fair man as being unjust. We don't object to the telephone company using our right-of-way and our road, but we would object, and most strenuously, to completely rebuilding our line on that account. The industry, or the manufacturers rather, are not forgetful of the situation, and they realize, and have realized for some time that the present form of electrolytic lightning arresters has caused a lot of trouble to the telephone interests. They have been working on the line of an electrolytic arrester that will not require charging. They have developed that arrester to the point where it can be used up to 15,000 volts, and it is only a question of time when it can be used to 60,000 and 100,000. Ultimately we will get an arrester that will not require charging, that will eliminate almost entirely the interference due to charging lightning arresters. We have gone to a considerable trouble and expense to charge our lightning arrester at a time that is suitable to the telephone interests, but if we had to hire a man to get up between two and three o'clock in the morning to charge the lightning arresters and do nothing else it would put a great burden upon us, as that man would be of no use the rest of the day. It is not reasonable to require that.

I admire greatly the work done by this committee in California. It is a splendid work. I would like to repeat what I said in San Francisco when Mr. Babcock submitted a report

of progress. I stated that in my opinion, the electrical fraternity, not only of the United States, but of the world, was indebted to this committee for the work it had done. I don't consider, however, that it is fair to impose the burden upon this committee of continuing that work, and in my opinion, it should be taken up by some national body. At the time I made the suggestion I had no idea what national body would naturally do this, but since then the suggestion has been thrown out, and it is a splendid one, that the Bureau of Standards should take up this work, and make a thorough investigation to satisfy us that the telephone company was doing all it could reasonably be expected to do, and to satisfy the telephone company that the same requirements were being met upon our part.

Incidentally, I would call your attention to the fact that there are some things that the telephone company does not know about their own apparatus. We have been assured time and again that the standard fuse is only good to protect up to 5000 volts. The Bureau of Standards discovered that it was safe up to 7500 volts, and probably a good deal higher. As a result of that discovery the code which the Bureau of Standards is now working on, will provide that the highest grade of construction for crossings will only be required in cases of over 7500 volts instead of 5000 as we have heretofore been told was the limit. I believe a great deal could be done in the way of co-operation, and if the telephone interests desire, I am perfectly sure that our committee—and we represent practically every power company in Oregon, Washington and Idaho—will be more than glad to meet with them at any time, and go into this question and see what can be done, and all I ask of the telephone interests is to forget the California order.

F. D. Nims: Sometime before the California ordinance was brought to notice in Spokane, I had a few differences with the telephone company in British Columbia. We fought things over for two years, and finally, came down to an agreement, and since that time things have been adjusted in a friendly way, satisfactory to both sides. But, it wasn't along the lines as laid down by the California commission. There are several points in there I might call your attention to. One is, that the rulings of the California commission cover any communication circuit. That, if applied to the states of Oregon and Washington, and particularly the company I am connected with at the present time, would mean we would have to go out of business, because we are in a district that is the most heavily timbered in the Northwest, and almost the only communication circuits there are little farmer lines. They generally go out of business in September, and they do not fix them up until May again. Sometimes they are out of service for three or four months of the year. We would be compelled to put up the construction which would absolutely prohibit getting business, as we could not stand the expense.

The form of the California ruling is a little long and the language is somewhat indefinite. In one instance, there was an appraisal of four communication companies. Under the California ruling every one of these would have to space his transmission off or we would be compelled by the commission to get together and get some kind of a joint ruling. In the definition of a "parallel" which separation constitutes a parallel? That is probably determined upon by the circumstances. But, we have today, a few difficulties with one telephone circuit from the charging of the electrical arresters on the circuit of another company, which are twenty miles away. They parallel us for a distance of about thirty miles across Puget Sound. Every time they charge their arresters our telephone line is out of business for a minute or two. Again, it is just the other way around, and when we charge our arresters they find that the same thing happens on their telephone lines, but I have talked to several people of the telephone company, and they have not noticed it. A tele-

phone line runs parallel to us and 60 ft. away for twenty-four miles and they do not feel any ill-effects from the charging of our arresters. This is one of those points which I think brings back the point Mr. Martin made, and this point should be more thoroughly investigated before any laws are laid down, laws which are as mandatory as the California laws.

V. H. Greiser: In listening to the remarks this evening, co-operation seems to be the principal thing brought out, and I assume from that that when the power companies hand the telephone companies a bat in the ear or vice versa, the telephone companies are going to turn around and hand the power companies a bat in the ear.

Some four years ago I had the pleasure of meeting Mr. Griswold in Spokane, and the subject of "Interference" was brought up I think with reference to the very line Mr. Fiske described. In the conversation with Mr. Griswold I told him I didn't believe that firm knew what to do. They didn't know enough about the telephone business to make up their own mind what charge they should make in operation or construction, and I asked him a frank question what we could do. Griswold very frankly replied that he didn't know himself at that time. He then described the situation to me as it was in California. That is, that the committee was in the process of formation, and until they had made their investigation it would be impossible to tell who should do anything or whether anything could be done. Our power engineers have been much interested in what has been published of the committee's report of California, but, on the other hand, the power engineers and operators have been very much disappointed in not securing more in detail of the test processes and detailed results as this investigation was carried along. In other words, the power engineers today, outside of the committee, do not know how these conclusions were arrived at. They feel rather uncertain about them for that reason. It is all very well to have somebody tell us, "Take this medicine and you will feel better," but we would like to know, nevertheless, just what kind of medicine it is, especially since it is the first year.

There is not a power man in the country that has paid any attention to the subject whatever but would feel glad to work with the telephone company as far as possible along this subject. Of my own knowledge, I have seen the oscillograph write the harmonics and I have heard they exist from the telephone men, so I know they must get them, but we would like to know what to do so that we could be sure our efforts would bear results. So the burden is not on us completely. We are really doing part of the telephone companies' work for them. We are bound to be prejudiced in our own favor, and since the telephone men are usually only human, we have a conception that might be a little bit prejudiced to our own side of the game. For that reason it seems obvious that if an independent party could be brought into this subject to clarify it for us and make us both feel that the thing could be worked out, that would undoubtedly be the best solution for all concerned. We would have everything settled by arbitration like the International Peace Congress, which has been so successful. We would have a few things settled ourselves. It seems as though it might be advisable to allow us to reach a definite result soon. This matter should be put in the hands of some learned and independent body as has been suggested by several of the previous speakers. For instance, the United States Bureau of Standards. They have the equipment and the best scientists of the country. If they haven't any power men they can get them. There is plenty of material in the country. They only need money and equipment, and they desire to get into it and develop the real science of the situation, and until something of that character is done we all must try to co-operate. We are all of us very much tied up in our own interests and cannot always see the other fellow's side as much as we should.

(To be continued.)

A COMMENDABLE INSPECTION REPORT.

Laurin E. Hinman, electrical inspector for the City of Medford, Oregon, in submitting the annual report of the work done by his department during 1915 has set a standard which might well be followed by others. F. D. Weber, electrical inspector for the Underwriters' Equitable Rating Bureau of Portland, characterizes this work as "the most efficient electrical inspection in Oregon and a source of inspiration, as this is a city of only about 10,000 inhabitants."

During the year 2365 inspections were made and 613 permits issued. This included 1301 inspections on new wiring in business buildings, 756 newly wired residences, 250 on old wiring in business buildings and 94 old wired residences.

The nature of the installations and the kind of building in which the wiring was installed, is outlined as follows:

New business buildings wired.....	3
New residences wired.....	9
Old residences wired (not wired hitherto).....	21
New building additions to business buildings.....	6
Additions to original installations in business buildings....	236
Additions to original installations in residences.....	203
Repairs made to original installations in business buildings	59
Repairs made to original installations in residences.....	58
Business buildings rewired account hazardous installations.	5

Electric motors were installed to the number of 27 and a rating of 110.65 h.p., electric signs numbered 16, electric ranges 22, water heaters 35, air heaters 98 and hot-plates or flat rate service 18. The total value of the wiring inspected was \$14,079.

Report of New Construction.

New business buildings erected 1914—6. Cost.....	\$ 66,100.00
New business buildings erected 1915—3. Cost.....	115,500.00
New residences erected 1914—13. Cost.....	30,525.00
New residences erected 1915—9. Cost.....	18,300.00
Additions to business buildings 1914—7. Cost.....	6,750.00
Additions to business buildings 1915—6. Cost.....	5,150.00
Repairs to business buildings 1914. Cost.....	8,720.00
Repairs to business buildings 1915. Cost.....	530.00
Additions to and remodeling residences 1914. Cost..	3,340.00
Additions to and remodeling residences 1915. Cost..	6,200.00
Flues and chimneys constructed 1914. Cost.....	135.00
Flues and chimneys constructed 1915. Cost.....	500.00
Total of building operations year of 1914.....	\$115,570.00
Total of building operations year of 1915.....	\$206,415.00

During November, 1915, a new street-lighting contract was entered into by the city and the California-Oregon Power Company, whereby the present arc lighting system will be discontinued and replaced by the more modern series mazda system, using the type "C" nitrogen lamp of 200 and 400 candlepower; the city to make all replacements and renewals of burned-out lamps. Beginning with December 1, 1915, this department assumed making the renewals and replacements on the cluster lighting system and upon the completion of the series mazda system, will attend to replacements and renewals thereon.

Under the new street lighting contract the saving to the city during the month of December, 1915, for street lighting, is as follows:

124-250 watt lamps at \$3.00 each.....	\$372.00
48-100 watt lamps at \$1.20 each.....	57.60
69-3 light 40 watt clusters at \$1.50 each.....	103.60
14-5 light 40 watt clusters at \$2.50 each.....	35.00
	\$568.20

Allowance of 3 per cent of gross revenue inside city, exclusive of city bill.....	\$137.96
Amount allowed city (15 per cent) for making renewals	85.24
	\$223.20
Cost of making renewals for December, 1915.	8.145
	\$215.055
Total cost of street lighting for December, 1915.....	\$353.145
Cost to city under old contract \$685.35.	
Saving to city under new contract.....	\$332.205
	\$685.350

Master electrician's licenses were issued to the Medford Electric Company, Paul's Electric Store and Electric Construction Company.

Street lighting inspection required 226½ hours, public call and fire alarm system 93 hours and gravity pipe line telephone system 196 hours.

LETTERS TO THE EDITOR.

The Need for Teaching the Dealers.

Sir:—We heartily approve of your editorial on the subject of educating the dealers, as we believe that the large majority of the dealers do not have the proper understanding of costs of electric service and consequently cannot properly handle their sales arguments.

There is one point, however, that I believe you have overlooked in connection with this important problem, and that is that a certain amount of educational work must be done by the central stations with the customer before some classes of business are developed to the point where the dealer can profitably handle same. An especially good illustration is the electric range situation. The majority of central stations feel that as long as the present prices of ranges continue, ranges will have to be sold at practically cost and on deferred monthly payment basis. The dealers naturally cannot afford to handle this business, yet they are interested in having the range business go ahead rapidly, due to the fact that it results in a great deal of additional wiring and leads to more extended use of household appliances. Again, just as soon as range sales increase materially, prices, due to competition and to larger production on the part of the manufacturers, are bound to drop, at which time central stations undoubtedly will be only too glad to arrange their selling prices so the dealers can handle ranges.

I feel that all of the varied interests involved in the electrical merchandising problems should recognize the importance of quickly developing new uses of electricity and the importance of using special policies to accomplish this purpose.

You undoubtedly appreciate that one of the points involved is the necessity of selling central stations, during the development period, this special merchandise at prices as low as materials are sold the jobbers.

W. R. PUTNAM,

Sales Manager Utah Power & Light Co.

Salt Lake City, Utah, April 12, 1916.

Sir:—Regarding your editorial appearing in the Journal of the 8th instant, entitled "The Need for Teaching the Dealer," I entirely agree with your statement that all interested will get the best results when the intelligent co-operation of the dealers is obtained.

As you are aware, our company is spending a great deal of time and money in helping to develop the dealers throughout territory served by it. We can already see good results from this work and look for better results as the work continues.

I believe this is a work that must be followed up very actively by the central stations, jobbers and manufacturers, as well as the press, and I hope you will continue your efforts along this line.

S. V. WALTON,

Manager Commercial Dept. Pacific Gas & Elec. Co.,
San Francisco, Cal., April 11, 1916.

JOURNAL OF ELECTRICITY

POWER AND GAS

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Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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Unusual conditions of construction call for unusual means to meet them. The method of grouting a loose gravel foundation encountered after construction had been started on the Klamath River dam of the California-Oregon Power Company, as described elsewhere in these columns, is suggestive as to its application elsewhere.

While an engineer would not knowingly undertake such a task the exigencies of this case made it necessary continue after an undesirable dam site, as regards foundation, had been found. The owners were urging haste in constructing the dam and the situation had to be met by some immediate expedient. Hence the decision to grout two curtain walls to a depth of nearly one hundred and fifty feet below water level. So far as is known, no similar work has been done elsewhere. With the successful completion of this job it is thought that the methods might well be applied to the other sites where bed rock is at some distance from the surface.

The main lesson taught by this experience, however, is the necessity of thorough explanation of bed-rock with diamond drills before starting construction.

The decision of the directors of the Pacific Gas & Electric Company to substitute a standard pension system for the past "sympathetic"

A Commendable Pension Plan method is one worthy of emulation by other public utility companies. The justice of thus providing for the disability or old-age of corporation workers is so well established as to need no argument.

This pension plan provides for the retirement and pensioning of any employe at the age of sixty-five years after fifteen years of continuous service, of any employe who becomes permanently disabled after twenty years' or in the case of a ten-year employe disabled by injury received while actually at work. The pension allowance for each year of service is on the basis of one and one-half per cent of the average monthly pay received for the ten years prior to retirement, the minimum being fifteen dollars per month.

This is thus seen to be a straight pension plan, independent of any form of insurance or sick benefits. It is humanitarian in scope and should be most efficient in action.

Opportunity consists in the answer to a need. In the electrical field at this time, the rapidly increasing cost of materials and delay in deliveries—"due to the war"—calls for vigilance and research, that economies may be effected and possibly better methods evolved. It does not necessarily follow that the better way now to be adopted must be "new." The old order—the supplanted method or discarded materials—may now offer the betterments desired.

Improvement Through Substitution

So the lighting fixture manufacturer and dealer may now be able to induce a complete change of style in lighting equipment that will result in lighting not only more pleasing but more economical.

Lighting glassware came onto the market in answer to a need. Energy costs were high, lamps comparatively inefficient and at that were not installed to produce maximum results. The glassware manufacturers grasped this opportunity.

But the continued downward revision of rate schedules and the wonderful improvement of lamps have made unnecessary the complete utilization of light flux to the end of a bare physical efficiency, while the increased intrinsic brilliancy of the improved light sources has made it undesirable.

A partial reversion to the materials of the pre-glassware period in lighting—silk, cretonne and other goods, paper, transparent mica, gelatine, wood and plaster—would not, in view of other advances, show retrogression, but would result in more artistic and, especially as regards the home, in more appropriate lighting.

The Japanese advantaging opportunity—eager to capture the markets temporarily lost to the other nations and appreciating the impossibility of the general and quantitative use of expensive materials—have already placed on the market an attractive though characteristically Japanese line of cardboard and paper, wood and silk, and metal and silk shades for electric lamps. The facile faculty of imitation which that people possess has enabled them to adapt their materials in part to American designs, but the satisfactory solution and full advantage of this situation lies in the utilization of home products and native genius.

As a change is always in season and initial cost economies must be effected, an exceptional opportunity is here afforded for any who will adequately meet this need.

Now that the advantage of innumerable electric range consumers rather than a few large power users has been recognized by electric power companies this class of business is being accorded a low rate and consequently a great number of ranges are being sold in the West. Much of this has been accomplished by house-to-house canvassing and word-of-mouth selling. Other more effective means are available and well worth consideration.

In the first place, stimulate and intensify interest by an electric range week, during which special demonstrations of electric cooking can be given by every dealer in a town. Let the central station and the several range manufacturers co-operate in an educative advertising campaign in the local newspapers, telling where demonstrations are being given. Substantial prizes might likewise be offered for the most beautiful and attractive displays by electrical dealers, house-

furnishing stores and others selling electric stoves, ranges being furnished by central station or manufacturer and prizes being awarded to each class of business house participating. Each store should also conduct a guessing contest as to how many electric ranges will be sold during the month of May or June, the range on display being awarded to the nearest guesser.

Nor should the "movies" be neglected. Slides and short films on the pleasures of electric cooking should be displayed in every moving picture house. Special inducements in the way of cooking utensils as premiums will be found to have a peculiar persuasive power on women.

It is advisable to have talks on electricity given at all club meetings and schools, giving a working demonstration of electric cooking in each case. In some instances it is even desirable to present a range to a woman's club or domestic science school where it may be used by many different people.

A competition in the writing of compositions among the school children would command much attention if an electric range, electric oven, electric percolator and electric toaster were offered as prizes for the best writings on some such subject as the efficiency of electric cooking. Children's questions in the home and elsewhere are far-reaching in effect and productive of excellent results.

By simultaneous action on each of these and other plans during a week a deep and lasting impression can be made on the public mind so that the effect will be felt for many a month to come. Such a movement needs the enthusiastic united support of everybody in the electric business. Street car cards, automobile banners, bill-boards, electric signs and newspapers should all be used. Every electric salesman, whether from central station, jobber or dealer should think, act and talk electric ranges. The Jovian Leagues can do yeoman service in this respect.

Never has there been such an opportunity for every branch of the electrical industry to participate in profits as is afforded by the electric range today. The manufacturers are putting out fine ranges at reasonable prices, the central stations are offering low rates and the public is anxious to enjoy the novelty and convenience of electric cooking. Every range sold means wiring for the contractor and a profit for the dealer.

One effect of the ever operating central station-jobber campaign on lamp socket devices which has been conducted by the Pacific Gas & Electric Company during the past four months has been to demonstrate the ability of the electrical dealer as a potential load builder. The dealers have awakened to the chance that they have to sell appliances and will hereafter handle the sales without the crutch hitherto provided. Electric ranges offer even greater inducement to dealers' activity.

Suggestions for an Electric Range Week

PERSONALS

D. E. Bailey, of the Bailey-Drake Company, of San Francisco, is at Los Angeles.

E. J. Hall, of the Electric Novelties Company, San Francisco, is confined to his home by illness.

Garnett Young, general manager Telephone Electric Equipment Company, is at Los Angeles.

G. H. Bradt, vice-president of the Wizard Electric Lamp Company of San Francisco, is at New York.

G. T. Lundle, of the Tonopah Wire & Electric Company, has returned to Tonopah from San Francisco.

E. J. Hampton, of the Hampton Electric Company, San Francisco, has just returned from a short trip.

Guy Moore, of the Moore-Rose Company of Healdsburg, was a recent business visitor at San Francisco.

H. C. Munter, Pacific Coast manager of the Hughes Electric Heating Company of Chicago, is at Los Angeles.

M. T. Cook, general manager of the Pacific Coast for the Western Union Telegraph Company, is at San Francisco.

L. S. Ready, engineer in the gas and electric department of the California Railroad Commission, is at Los Angeles.

J. M. Nightingdale, electrical contractor and dealer from Modesto, has returned home after a visit to San Francisco.

A. H. Neuland, of the Neuland Electric Company, has moved the company's laboratory to San Francisco from New York.

A. G. Wishon, general manager of the San Joaquin Light and Power Corporation of Fresno, was at San Francisco this week.

A. G. Zeitschel, formerly with the Electric Appliance Company of San Francisco, has recently joined the sales force of the Baker-Joslyn Company.

A. H. Noyes, of the Electric Appliance Company, has recently returned from a business trip throughout the northern part of California and southern Oregon.

Paul C. Butte, of the Butte Engineering Company, has returned to San Francisco from a trip in the San Joaquin Valley overlooking the installation of an electrical bridge equipment at Middle River and Old River.

P. D. Frazier has resigned as general foreman of operation and maintenance for the Great Western Power Company at Oakland, Cal., to become superintendent of construction for the Alabama Power Company, at Birmingham, Ala.

Walter B. Smith, formerly with Holabird-Reynolds Company, of San Francisco, and J. C. Hobrecht Company of Sacramento, who recently returned from an extended trip to Australia, has joined the sales force of the Baker-Joslyn Company of San Francisco.

Max Lowenthal, electrical specialist for the Dohrman Commercial Co., at San Francisco, has visited the stores of the syndicate throughout the state in the interest of the electrical departments, giving talks to the employees and reorganizing the departments.

B. C. Hill, supervisor of electric inspection for the City of Oakland, has been elected president of the California Association of Electrical Inspectors, **Frank Ellison** being vice-president and **A. J. Cleary**, secretary. The next meeting will be held at Stockton, May 8th.

Wynn Meredith, civil engineer and member of the firm of Sanderson & Porter, **G. W. Dickie**, mechanical engineer, **C. W. Merrill**, mining engineer, **A. B. Babcock**, electrical engineer Southern Pacific Company, and **Edmund O'Neill**, professor of chemistry, University of California, have been appointed California members of the National Industrial Survey by the Naval Consulting Board.

Clyde B. Aitchison, chairman of the Public Service Commission of Oregon, as announced in these columns April 15th, has accepted the position of solicitor for the National Association of Railway Commissioners, in connection with the pending appraisal of the railroad, telegraph and telephone systems of the United States being made by the Interstate Commerce Commission. Mr. Aitchison's headquarters will be at Washington, and his new work will necessitate his resignation from the Oregon commission. Considerable work now pending under submission before the commission will be cleared up before Mr. Aitchison will make his intended resignation effective. Probably his resignation will not become effective and a successor be qualified before the first of June. The position tendered Mr. Aitchison is a new one. It will be his function to represent the interests of the States and State



Commissions at Washington during the federal appraisal. The carriers have a strong organization for the protection of their interests. It was the unanimous view of the state commissioners at the annual convention in San Francisco last fall that representation by the states was absolutely required in the public interest, and members of the Interstate Commerce Commission have strongly urged the importance of the state commissions taking such action in the public interest. Up to the present time, the only appearance before the Interstate Commerce Commission in opposition to the claims of the carriers has been made by volunteers and committee from the state commissions. Mr. Aitchison has been a member of the Oregon commission since 1907, when (under the name of Railroad Commission) it was created. He was elected in 1908, and again in 1912, and his term expires in January, 1917. He was one of the joint authors of the railroad commission act, and drafted the present public utilities law. Previous to his appointment on the railroad commission, he was, in 1905 and 1906, the secretary of the Oregon Tax Commission, appointed to redraft the tax laws of the state. He has served as counsel for the Oregon commission since its organization, and in more than nine years no order of the Oregon commission has been vacated by any court. Mr. Aitchison is lecturer on the law of Water Rights in Northwestern College of Law, in Portland.

George W. Martin and J. Grant De Remer have announced the organization of an engineering firm with offices at 100 Broadway, New York, for general practice in public utilities and industrial plants. Mr. Martin graduated from Stevens Institute of Technology in 1890. After spending several years in the heating contracting business in New York City, he became associate editor of Cassier's Magazine and later editor of the Electrical Age. Resigning to accept a position with Ford, Bacon & Davis, Mr. Martin was engaged in engineering construction work in the south. Later he was employed under Dr. Jacobus of the Babcock & Wilcox Company, resigning to organize the New York Service Company, for the operation of individual steam plants. In this connection Mr. Martin has specialized in plant operation and power costs. He will retain his interest in the New York Service Company as its vice-president. Mr. De Remer comes from the West. He graduated from the University of California in 1907, and immediately joined the staff of the Westinghouse Electric & Manufacturing Company as assistant to the manager of the San Francisco office, where he remained until 1910. Upon the organization of the United Light & Power Company of San Francisco, he became its vice-president and later chief mechanical and electrical engineer, in which capacity the electrical properties and steam heating systems of that company were under his direct supervision until he resigned in 1914 to join the American District Steam Company of North Tonawanda, N. Y. On January 1, 1916, he resigned the position of manager of the general engineering department of this company to remove to New York for the purpose of entering upon this new engineering enterprise. In developing the district heating business in San Francisco, and later in examining and reporting upon heating properties in various parts of the United States, Mr. De Remer has acquired a large experience and an intimate knowledge of the heating industry, which will be a valuable assets to the new firm in that special field. The new organization will interest itself to a considerable extent in the financial development of new and existing properties. The firm will be known as Martin & De Remer.

MEETING NOTICES.

Great Western Power Co. N. E. L. A. Section.

Two meetings of this newly-organized section have been held, one in San Francisco, where P. D. Frazier read a paper on the early history of the company, and one in Oakland, where J. W. Beckman read one regarding a new electro-chemical plant at Pittsburg, Cal., for the manufacture of caustic soda and bleaching powder from sea salt and limestone. A meeting will be held in the near future to inspect the company's new exhibit of electric ranges at San Francisco.

Los Angeles Jovian League.

A pleasing and instructive diversion was provided at the meeting on April 12th, by S. J. Keese, chairman of the day, in a lecture on "Colored Photography," which was explained and illustrated on the screen by photographic slides taken in their natural colors. Herbert J. Goudge, the principal speaker of the day, discussed the theory of the spectrum, and explained with the aid of lantern slides, the process of decomposing light with the spectroscope. He was followed by T. C. Low, also an authority on spectroscopy, who explained the intricate details of color photography, and illustrated his talk with photographic slides of scenery and flowers that almost rivaled nature in their beauty of color. Dr. Dain L. Tasker and S. J. Keese also exhibited color photographs made by themselves, and it was long past the regular time for adjournment when the interesting entertainment was brought to a close by Acting President J. N. Colkitt.

San Francisco Electrical Development and Jovian League.

The league luncheon of April 12th was more or less the occasion for boosting the Jovian smoker on the 14th. Vice-president C. C. Hillis, first introduced Murray Orrick, First

Tribune of the Jovian Order, as chairman of the day, who had provided an interesting entertainment. A. E. Rowe was asked to tell some of the details about the smoker and Albert H. Elliot was introduced as speaker of the day. Mr. Elliot gave a soul-stirring speech on co-operation as a means of bringing about world peace, his remarks being heartily applauded. Nearly 200 electrical men assembled Friday evening at the Jovian smoker held at a local hotel. A wealth of entertainment and refreshment had been made ready and was greatly enjoyed by all present. The active workers in arranging this affair were Tribunes Murray Orrick and E. A. Wilcox, Al Drendell, Earl Fisher, A. H. Halloran, A. E. Rowe, Wm. Neelands and H. E. Bittman, together with Tribunes F. H. Woodward and B. C. Hill of Oakland, who headed a big trans-bay delegation of guests. The Oakland Jovians have invited the San Francisco Jovians to an entertainment in the club rooms of the Oakland Commercial Club at an early date. A committee consisting of Hugh Kimball, Geo. King, Julius Genzler, Lee Gilpen, Carl Hardy, Geo. Furniss and Albert Nysten, has been named to complete arrangements.

Northwest Electric Light & Power Association Convention.

Plans are being rapidly matured for the ninth annual convention of the Northwest Electric Light & Power Association at Seattle, September 6, 7, 8 and 9, 1916. The Pacific Coast meeting of the American Institute of electrical Engineers will be conducted at the same time and place, and there is also a possibility that the Pacific Coast Electrical Supply Jobbers' Association will do likewise. The following papers will be presented and discussed:

"Application of Overhead Line Construction Rules of the Public Service Commissions of the Northwest," Editor, M. T. Crawford, Puget Sound Traction, Light & Power Company, Seattle; "Effect of Obsolescence of Equipment on Cost of Service," Editor, Leslie Craven, Portland Railway, Light & Power Company, Portland; "The Employer as an Educator of the Public," Editor, Arthur Gunn, president Wenatchee Valley Gas & Electric Company, Wenatchee; "Merchandising and Operating in Small Towns and Rural Communities," Editor, Pacific Power & Light Company.

Range Committee Report: W. R. Putnam, chairman; M. C. Osborne, S. V. Walton, H. J. Gille, A. C. McMicken, S. M. Kennedy.

Round Table Conference: Conducted by E. G. Robinson, president Northwest Electric Light & Power Association; "Co-operation Between Central Stations, Manufacturers, Jobbers and Contractor-Dealers," Editor, W. L. Goodwin, vice-president and sales manager Pacific States Electric Company, San Francisco, Cal.

Portland Section A. I. E. E. and N. E. L. A.

The luncheon on April 13th was held under the auspices of the North Coast Power Company. The speaker of the day was Wm. D. Wheelright and his subject was "The League to Enforce Peace." The league was formed on Bunker Hill Day, 1915, in Independence Hall, Philadelphia with Ex-President W. H. Taft as president. It was formed to establish and enforce peace after the present European war and operates through a judicial tribunal and a conciliatory council. If any one country should declare war without submitting its grievance to the proper tribunal all the others in the league would withdraw their economic forces and try to suppress same.

The regular monthly meeting was held April 11th, in the Auditorium of the Electric Building. J. E. Davidson acted as chairman, M. E. Cheney, electrical engineer, electrical inspection department, Washington Surveying and Rating Bureau, presented a paper on "The Scientific Construction of Utility Insurance Rates." The secretary read a letter from the sub-committee on exhibits for the Chicago convention asking whether or not the local section desired to send an exhibit to the convention. Upon motion, the chairman appointed a committee of three to investigate the advisability of

entering an exhibit from the section. The committee consists of Messrs. Broili, McMicken and Moody. The secretary submitted a report on the joint meeting which had been held thus far this year. A new constitution and by-laws was adopted by the Institute section providing for local members paying two dollars for annual dues.

After the reading of the paper and business meeting the section enjoyed a buffet lunch. Attendance 45.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Martinez & Concord Interurban Railway Company has applied to the commission for authority to issue 1050 shares of its common stock at not less than \$45 a share; \$125,000 face value of its first mortgage bonds at not less than \$90 and \$125,000 of its cumulative participating at not less than par.

The Great Western Power Company has applied to the commission for authority to use the sum of \$500,943.10, a part of the \$1,350,000 received by the sale of the capital stock of the City Electric Company to the Great Western Power Company of California, to reimburse expenditures between June 1, 1915 and February 29, 1916, for expenditures and betterments.

The commission has issued an order authorizing the Chetco Southern Telephone Company, of Harbor, Oregon, to sell a one-half interest in the telephone system at Crescent City, Del Norte to the Del Norte People's Telephone Company. The purchase price is \$2000.

The Peoples Gas Company of California in an application accompanied by applications from all the companies involved, asks the commission for authority to buy the gas properties of the Southern Counties Gas Company of California, the Long Beach Consolidated Gas Company, and the Southern California Edison Company, excepting the Santa Barbara plant of the latter corporation, for \$2,750,000 par value 20 year 5½ first mortgage bonds of \$650,000 par value 6 per cent debentures and \$2,000,000 par value of common stock of the People's Gas Company. The company also asks permission to issue \$15,000,000 5½ per cent 20 year first mortgage bonds and to sell \$2,750,000 par value now; to issue also \$2,000,000 of 6 per cent ten-year debentures, and \$650,000 of that amount now; \$2,000,000 par value common stock. The \$15,000,000 bonds are to be secured by a trustee deed, and the \$2,000,000 of securities by a second mortgage.

NEWS OF IDAHO PUBLIC UTILITIES COMMISSION

The commission has granted a certificate of convenience and necessity to the Electric Investment Company for an extension of its electrical transmission and distribution system from Meridian to Kuno, Ada county, Idaho.

EXAMINATION FOR VALUATION ANALYST.

The United States Civil Service Commission announces an open competitive examination for valuation analyst to fill several vacancies in the Division of Valuation, Interstate Commerce Commission, salaries in the first grade ranging from \$3600 to \$5000 per annum, and in the second grade from \$1800 to \$3300 per annum. The duties of this position will be to compile data and to prepare complete, concise and logical reports upon valuation subjects and to analyze, edit and digest reports submitted by sections of the Division of Valuation. Competitors will not be assembled for examination, but will be rated on education (30), experience (30), reports and writings submitted (40). Applicants for positions under grade 1 must show that they have had at least eighteen months' responsible, satisfactory experience in the final preparation of financial, statistical, or valuation reports upon public utilities. For grade 2 positions, such experience for at least six months must be shown. In each case this experience should have been gained in the employment of a public authority or commission engaged in the effectual regulation of public

utilities, or with an important public utility, or in investigations of a similar character. Experience with mercantile concerns, with large utilities in routine positions, or with small utilities with limited operations will not be accepted as qualifying experience in this connection.

HEARING ON ENGINE SAFETY ORDERS.

The Industrial Accident Commission of California will hold a public hearing on engine safety orders at San Francisco on April 25th and at Los Angeles on May 9th. In 1914, there were in the State of California 15 deaths from accidents due to engine hazards, 99 permanent disablements and 1451 temporary disablements, giving a total of 1565. There were 23,138 days lost to injured workers as a result of the 1451 temporary disablements. The total cost of compensation and medical payments for the 1565 accidental injuries was \$99,599.06. The following committees prepared the Engine Safety Orders:

San Francisco Committee on Engine Safety Orders: F. H. Varney (chairman), chief engineer operation and maintenance Pacific Gas & Electric Company, representing the users of engines; (F. W. Small, Pacific Gas & Electric Company, alternate to Mr. Varney); E. A. Selfridge, Jr., Northwestern Redwood Company, representing the lumber interests; W. H. Healy, president Healy-Tibbitts Construction Company; (J. N. Lohse, Healy-Tibbitts Construction Company, alternate to Mr. Healy; P. L. Ennor, representing the International Association of Steam and Operating Engineers, Local No. 64; (W. R. Towne, representing the International Association of Steam and Operating Engineers, Local No. 64, alternate to Mr. Ennor); J. T. Thorpe, representing the International Association of Machinists; R. L. Hemingway, safety engineer Industrial Accident Commission; John R. Brownell (secretary), superintendent of safety Industrial Accident Commission; (Mr. Varney died shortly after the engine safety orders were completed).

Los Angeles Committee on Engine Safety Orders: W. Lewis Bell (chairman), president Fulton Engine Works; George S. Graham, Fairbanks-Morse Company; David Brian, chief engineer Hotel Clark; George C. Flint, Los Angeles County Erecting Engineer; J. A. Young, chief engineer Western Gas Engine Company; Henry Wiatt, superintendent Electric Manufacturing, Los Angeles Gas & Electric Corporation; Ernest Cowelson, representing Machinists' International Union No. 311; H. L. Boyd (secretary) safety engineer Industrial Accident Commission.

NEW CATALOGUES.

Bulletin No. 202-I from Standard Underground Cable Company details Colonial Copper Clad Wire as to uses, methods of manufacture, specifications and comparative properties.

The Usona Manufacturing Company of San Francisco have issued a neat booklet illustrating and describing "Kwik-lite" battery flashlights, hand lights and batteries.

Booklet No. 51 from Hurley Machine Company, is being distributed by the Pacific States Electric Company. The complete line of Thor washing machines, ironing machines and vacuum cleaners are illustrated and described.

Electrical Blue Book, seventh edition; Electrical Review Publishing Company, Chicago; list of approved construction material and fittings, national electrical code, illustrated; A. I. E. E. code of professional conduct, street lighting schedules, etc.

An attractively illustrated art circular has just been issued jointly by the Pelton Water Wheel Company of San Francisco-New York, and the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., describing the Pelton-Westinghouse water wheel generator sets and their applications.

DOMESTIC ELECTRIC RANGES.

Herewith is presented a tabulated list of specifications of various makes of electric ranges. Data have been given only for those manufacturers or sales representatives who have been reached during the limited time available for this compilation. Further details will be given subsequently.

In general, it may be stated that all these makes of electric ranges have much the same appearance as a gas range,

thus introducing no confusing feature to the housewife. Burners are capable of giving three heats—high, medium and low—by means of indicating snap switch. Ovens are generally equipped with thermometers and lined with some insulating material so as to cook with retained heat and thus greatly reduce current consumption. Two oven heating elements are employed, one on the bottom and one on top, this also being used for broiling.

General Electric Company

No.	Type.	Oven Wattage.	Number and Wattage Service Burners.	Total Wattage.	Oven Dimensions.	Oven Insulation.	Finish of Range.	Type of Heating Unit.	Shipping Weight.
R 1	Oven low	1000 1000	2-1000 3-2000	4600 w.	18x18x12	Colorox	Coach Body	Sheathed wire, cut in	355 lbs.
R 2	Oven above	1000 1000	2-1000 3-2000	4600 w.	18x18x12	"	"	"	500 lbs.
R 3	Oven side	1000 1000	2-1000 3-2000	4800 w.	18x18x12	"	"	"	670 lbs.
		1-warmer 200 w.							
R 4	Oven side	1000 1000	2-1000 3-2000	4600 w.	18x18x12	"	"	"	389 lbs.
S 1	Oven low	1500 Broiler 1000	3-1000	5500 w.	18x18x12	1½" air-cell Asbestos	Black Japan	"	222½ lbs.
S 2	Oven above	1500	3-1000	5500 w.	18x18x12	"	"	"	250 lbs.
S 3	Oven side	1500	3-1000 1-2000	5700 w.	18x18x12	"	Black Japan and White Enamel	"	385 lbs.

Globe Stove & Range Company.

No.	Type.	Burner Wattage.	Oven Wattage.	Total Wattage.	Oven Dimension.	Oven Insul.	Finish.	Heating Units.	Shipping Weight.
A 2	2 low ovens	1-1500 1-1100 2- 880	1-1500 3-1000	8860	19x20x13 12x12x13	"Kiesel guhr."	Nickel or white porcelain enamel steel	Open type chromed wire backed with asbestos lava and covered with metal wearing plate	
E 2	1 side oven	1-1500 1-1100 2- 880 1- 330	1-1500 1-1000	7190	13½x13½x19	"	"	"	
B 3	1 low oven	1-1500 1-1100 1- 800	1-1500 1-1000	5900	"	"	"	"	
B-4	1 side oven	1-1500 1-1100 1- 330	1-1500 1-1000	5090	"	"	"	"	
B 5	1 high oven	1-1500 1-1100 1- 880 1- 330	1-1500 1-1000	6310	"	"	"	"	

Hot Point Electric Company.

No.	Type.	Burner Wattage.	Oven Wattage.	Total Wattage.	Oven Dimension.	Oven Insul.	Finish.	Heating Units.	Shipping Weight.
D	1 side oven	1-1500 1-1200 2- 800	2-1200	6700	18½x18½x12 18½x18x10	Mineral wool	Black Enamel	Glowing coil reflector	275
E	1 side oven	1-1500 1-1200 1- 800	2-1000	5500	16½x16½	"	"	supported by steel	240
F	1 high oven	1-1500 1-1200 1- 800	2-1000	5500	"	"	"	truss and porcelain frame	195
G	1 high oven	1-1500 1-1200 1- 800	2-1000	5500	"	"	"	"	195
H	I low oven	1-1500 1-1000	2-1000	4500	"	"	"	"	140

Western Electric Company.

No.	Oven Position.	Top Burners.	Surface Wattage.	Oven Wattage.	Total Wattage.	Oven Insul.	Oven Dimensions.	Heating Units.	Shipping Weight.
C-2	Side	2	2600	1760	4360	Rock Wool	18x12x12"	Open	240 lbs.
C-3	Side	3	3480	1760	5240	"	18x12x12"	"	260 lbs.
C-4	Side	3	3480	2200	5680	"	18x18x12"	"	275 lbs.
C-17	Above	2	2000	None	2000	"	18x11x8"	"	90 lbs.
C-18	Low	2	2600	1760	4360	"	18x12x12"	"	150 lbs.
27	Low	2	2600	1760	4360	"	18x12x12"	"	150 lbs.
30	Low	3	3480	1760	5240	"	18x12x12"	"	150 lbs.
33	Above	3	3480	1760	5240	"	18x12x12"	"	250 lbs.
37	Low	3	3480	2200	5680	"	18x18x12"	"	175 lbs.
40	Low	4	4360	2200	6560	"	18x18x12"	"	185 lbs.
44	Above	4	4360	2200	6560	"	18x16x12"	"	270 lbs.
47	Side	3	3480	2200	5680	"	18x18x12"	"	350 lbs.
48	Below	6	6340	2200	8540	"	18x18x12"	"	225 lbs.
50	Side	4	4360	2200	6560	"	18x18x12"	"	335 lbs.
56	Side	4	4360	4000	8360	"	18x18x12"	"	430 lbs.
60	Side	6	6340	4000	10340	"	18x18x12"	"	500 lbs.

Westinghouse Electric & Manufacturing Co. Automatic and Non-Automatic.

No.	Type.	Burner Wattage.	Oven Wattage.	Total Wattage.	Oven Dimensions.	Oven Insul.	Finish.	Heating Unit.	Shipping Weight.
3-19	Side oven	1-2000 2-1000	2000 850	6850	18½x13½x16 10¾x13½x11½	Rock Wool	Nickel or Japan	Radiant Open Coil	400
2-19	Low oven	1-2000 2-1000	2000	6000	18½x13½x16	"	"	"	295
406	Low oven	2-1000	1660	3600	16½x12x11½	"	"	"	90

Rathbone, Sard & Company.

No.	Type.	Burner Wattage.	Oven Wattage.	Total Wattage.	Oven Dimension.	Oven Insul.	Finish.	Heating Units.	Shipping Weight.
E 5	Low oven	4 units	2 units	5500		Duro therm.	Plain	Sheathed wire	
E 20	High oven	4 units	2 units	7000	1 separate broiler unit.	Duro therm.	Plain		
E 30	High oven	4 units	2 units	7000		Duro therm.	Plain		

Rutenber—Non-Automatic

105	Low oven	4 units 1000 w.	2 units 1000 w.	6000	18x18x14	Rock wool	Plain or nickel	Radiant spiral units	240
110	Low oven	3 units 1000 w.	2 units 800 w.	4600	18x12x14	Rock wool	Plain or nickel	in grounded porcelain supported by pressed steel container	210
115	Low oven	2 units 1000 w.	2 units 800 w.	3600	18x12x14	Rock wool	Plain or nickel		203
120	No oven	2 units 1000 w. 2000							50
125	No oven	3 units 1000 w. 3000							55

Simplex Electric Heating Company.

No.	Type.	Burner Wattage.	Oven Wattage.	Total Wattage.	Oven Dimension.	Oven Insul.	Heating Unit.	Shipping Weight.	Finish.
4 K	Oven low	2- 735 1- 440	1300	3210	15x12x11½	Mineral wool	Sealed in discs	200	Black Japan
5 K	Oven low	1-1300B 1- 735 1- 440	1300	2475	15x12x11½		Lock-on utensils	225	
6 K	Oven low	1-1300B 1- 735 2- 440	1600	4515	15x18x11½			243	
7 K	Oven low	1-1300B 2- 735 1- 440	1600	4810	15x18x11½			245	
8 K	Oven low	1-1300B 2- 735 2- 440	1600	5250	15x18x11½			250	
9 K	Oven low	1-1300B 1-1600 2- 735 1- 440	1600	5910	15x18x11½			295	
14 K	Oven low	1-2200B 1-1300 1-1100 1- 735 1- 440	2400	8175	21½x19x13			425	
21 K	Oven side	1-1300 1- 735 2- 440	1600 200	4715	15x18x11½			350	
22 K	Oven side	1-1300B 2- 735 2- 440	1600 200	5010	15x18x11½			350	
23 K	Oven side	1-1300B 2- 735 1- 440	1600 200	5450	15x18x11½			350	
24 K	Oven side	1-1300B 1-1100 2- 735 2- 440	1600 200	6110	15x18x11½			390	
31 K	Oven side	1-1300B 1- 735 2- 440	1600	4515	15x18x11½			325	
32 K	Oven side	1-1300B 2- 735 1- 440	1600	4810	15x18x11½			325	
33 K	Oven side	1-1300B 2- 735 2- 440	1600	5250	15x18x11½			325	
34 K	Oven side	1-1300B 1-1100 2- 735 2- 440	1600	5910	15x18x11½			365	

TRADE NOTES.

The Reliable Electric Company has finished the wiring and electric fixtures for the new Elite Market on Sacramento street, San Francisco.

Samuel A. Sizer, a large real estate and timber owner, of Portland, has joined the Ne Page, McKenny Company, electrical engineers and contractors of this city, as secretary and treasurer.

Arrangements are being perfected to form a baseball league among the employees of the San Francisco electrical jobbers. A game was played between the Westinghouse Electric & Manufacturing Company and the Electric Railway & Manufacturers' Supply Company on April 13, the former winning by a score of 12-3. The first ball was thrown by Samuel Taylor and caught by R. F. Behan.

The Interstate Electric Novelty Company has now moved to its new factory at 104 South Fourth street, Brooklyn. The flashlight industry has expanded so rapidly within the past few years that their former factory was not large enough to fill the demand for Franco products. The new factory which is seven stories high, containing nearly 100,000 square

feet of floor space, is equipped with the latest and most up-to-date machinery devoted entirely to the manufacture of Franco material.

One of the prominent electrical contractors said the other day: "I'm not getting any contracts lately. It's worse with me than it has ever been. Now, here, for example, is a specification sheet with figures for the different parts of the job, showing the actual cost of wiring detail with just a small margin of profit added and yet I am \$700 too high over the lowest bid. It has been that way more lately than it has been in the past. What's the reason?" I buy my stock just as close as any of them; I discount my hills. I don't pay any more for labor. I watch the job myself to see that there is no waste of material, no time lost, and I flatter myself I can put the job through as quickly and economically, if not quicker, than any other, because being at least thirty years in the business I ought to know how, and yet I figure \$2500 on the job, then actually cut out nearly all of my profits by reducing it to \$2225, and still some one figures \$700 lower. Is it any wonder the electrical contracting business is shot to pieces?



NEWS NOTES



INCORPORATIONS.

SAN FRANCISCO, CAL.—The Electric Sales Service has been incorporated with a capital stock of \$100,000, by W. W. Briggs, H. E. Kennedy, H. A. Mulvey, W. S. Leffler and W. S. Braun.

SANTA BARBARA, CAL.—The Santa Barbara Telephone Company has been incorporated with a capital stock of \$700,000, by R. E. Easton, E. A. Gilbert, G. B. Bush, A. Edwards and F. L. Rabe, to take over the Sunset and Home telephone systems in this city.

SAN BERNARDINO, CAL.—The Fontana Power Company has been organized here with a capital of \$350,000. The incorporators are A. B. Miller, J. C. Jones, R. H. Bassler, C. A. Stone, A. M. Wilson, all of Fontana, with the exception of Mr. Jones, who resided at Etiwanda. It is understood that company will develop water power in the mountains.

ILLUMINATION.

NOME, ALASKA.—At a recent election it was voted to issue bonds for the installation of a municipal lighting plant.

ALAMOGORDO, N. M.—The Alamogordo Light & Power Company's plant has been sold to the town of Alamogordo for \$25,000.

PT. ANGELES, WASH.—The contract for electric meters has been awarded by the city lighting department to the General Electric Company.

SAN PEDRO, CAL.—Petitions are being signed for the installation of ornamental street lights on Sixth street between Beacon and Pacific avenue.

LOS ANGELES, CAL.—The city council has granted a petition for the ornamental lighting of Hollywood Boulevard between Cherokee avenue and Wilcox avenue.

LOS ANGELES, CAL.—The board of supervisors has awarded a contract for street lights in the Sherman Lighting District to the Southern California Edison Company.

SOUTH SAN FRANCISCO, CAL.—The city trustees have entered into a contract with the Pacific Gas & Electric Company to install a new electric lighting system for this city.

VENTURA, CAL.—The Ventura County Power Company has applied for a franchise to extend its light and power lines along Ventura avenue and other parts of the county.

SANTA ANA, CAL.—The Southern Counties Gas Company has applied to the board of supervisors for a franchise to lay gas lines in all the beach towns which are now without a gas supply.

WESTLAKE, ORE.—Captain W. G. Campbell has left for Portland to see about arrangements for fluming the water power recently located between here and Clear Lake. Later, equipment will be put in to develop electric power.

PASADENA, CAL.—A resolution of intention has been adopted by the city council for the construction of a lighting system on Green street, and the issuance of bonds to cover the cost of the improvement.

BAKER, ORE.—Members of the merchants' committee of the Commercial Club called on the business men relative to the proposal of the city commissioners that the business men and property owners lend financial assistance in putting in cluster lights.

FLORENCE, CAL.—The town council has passed an emergency ordinance creating a light and water commission to handle all business in connection with the installation of a water and light system. J. G. Keating, Ramon Arballo and J. W. McCann are the members of the commission.

OAKLAND, CAL.—Elaborate plans for lighting Lincoln Highway beyond the city limits with electric lights were launched by Commissioner Jacosn, who introduced a resolu-

tion authorizing Carl E. Hardy to submit to the Council an estimate of the cost of installation and upkeep of the proposed system.

LOS ANGELES, CAL.—The city council has passed ordinances declaring intention to order the necessary appliances installed and electric current furnished for one year for lighting Figueroa street between Sixth and Tenth streets, Main street between Pico and Thirty-sixth Place, Arlington avenue between Pico and Country Club Drive and certain other streets.

PORTLAND, ORE.—Details for providing Portland with a municipal power house and lighting system from which it will derive 4000 horsepower of electric energy, are being worked out by the engineers of the public utilities department. The plans call for the erection of a hydroelectric generating plant on the Bull Run river in connection with an impounding dam, which soon will be necessary for the conservation of the city's water supply. The question of a bond issue for constructing the plant will be submitted to the voters.

TRANSMISSION.

WALLACE, CAL.—The city council has granted a right of way through the city to the Washington Power Company, which is preparing to construct power lines up Placer creek to the mines.

RIVERSIDE, CAL.—A new power company which proposes to build a transmission line from Temecula, through Fallbrook, Oceanside and Escondido, has filed application with the supervisors for a franchise extending from Elsinore to the San Diego county line, via Wildemar, Temecula and Murietta. Connection will be made with the Southern Pacific Company's line at Elsinore.

TRANSPORTATION.

COLTON, CAL.—An ordinance granting permission to the Pacific Electric Railway Company to construct single track railway connection at Ninth and J streets has been passed.

OAKLAND, CAL.—The city Council has adopted a resolution by which the San Francisco-Oakland Terminal Railways obtains the privilege, without obtaining a franchise, of establishing some kind of street car service between Broadway and Webster street.

TELEPHONE AND TELEGRAPH.

WENATCHEE, WASH.—A franchise for a telephone line in the Chelan forest has been granted to Forest Supervisor Milham.

FT. BAYARD, N. M.—Orders have been issued for the establishment of an underground telephone system here. Engineer W. S. MacDonald has been assigned to do the work.

FILLMORE, CAL.—It has been announced by the Pacific Telephone Company's Los Angeles offices that a thoroughly modern telephone system will be installed here in June or July, if not sooner.

COEUR d'ALENE, IDAHO.—A delegation of farmers north of the city appeared before the Chamber of Commerce asking for a telephone line. The chamber referred the application to a committee consisting of Dr. J. W. Scott, H. H. Tuft and H. A. Sampson.

NOGALES, ARIZ.—The La Usa Telephone Company has made application to the supervisors of Santa Cruz county for a franchise to construct telegraph and telephone lines from Amadoville to the county line and from the county line south of Arivaca to Oro Blanco and Jarillito, respectively.

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JOURNAL OF ELECTRICITY

POWER AND GAS

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SAN FRANCISCO, APRIL 29, 1916

PER COPY, 25 CENTS

LAYING POWER CABLES ACROSS SAN FRANCISCO BAY.

BY J. A. KOONTZ AND B. P. CORNELL.

WATER RIGHTS AS A LIABILITY.

MILITARY ENGINEERING.

BY CAPTAIN RICHARD PARK.

DISCUSSION ON INDUCTIVE INTERFERENCE ORDER.

BY L. T. MERWIN AND A. H. GRISWOLD.

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Boiler Feed Water Treatment

Dearborn Chemical Co.

Conduit and Cable

Sprague Electric Co.

Electrical Supplies

Electrical Ry. & Mfrs. Supply Co.
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Expansion Bolts

Western Electric Co.

Fire Extinguishers

Pacific States Electric Co.

Insulators

Hemingray Glass Co.
Pierson, Roeding & Co.

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McGraw-Hill Mfg. Co.

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Pelton Water Wheel Co.

Washing Machines

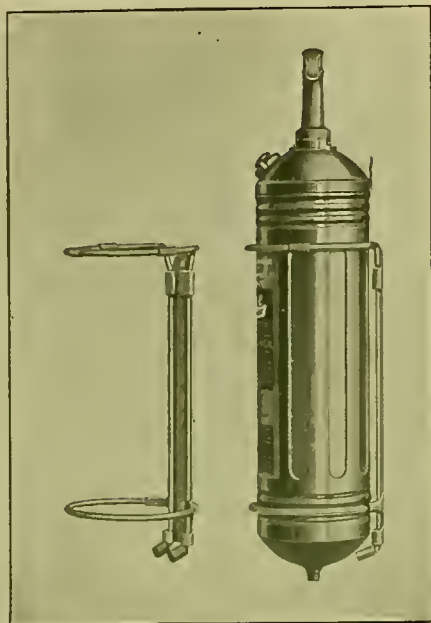
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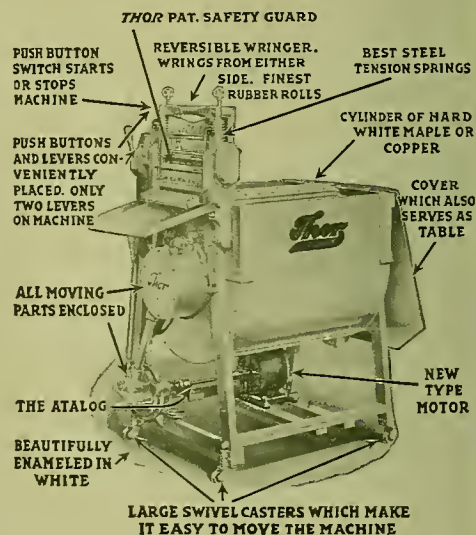
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(The paper on "Laying Power Cable Across San Francisco Bay," by J. A. Koontz and L. P. Cornell, as scheduled for this space, has been held up at the last moment, at the request of the executive committee of the local section of the American Institute of Electrical Engineers. The meeting devoted to this subject has been postponed from April 28th to May 26th, because of a special joint meeting of all San Francisco engineers on May 2nd regarding the subject of military engineering preparedness. The concluding portion of the series of articles on electro-metallurgy is consequently given this position.—The Editor.)

FEASIBILITY OF WESTERN ELECTRO-METALLURGY

BY DORSEY A. LYON AND ROBERT M. KEENEY.

Pig iron. In electric furnace smelting of iron ores electric energy is used to supply the heat necessary for reduction instead of charcoal or coke as in the blast furnace; and as only one-third or less of the charcoal or coke that is used in blast furnace work is needed in the electric furnace for the reduction of iron oxides, it is possible to produce in the electric furnace three times as much iron with one ton of charcoal or coke as in the blast furnace.

Raw materials and labor. The raw materials necessary for the manufacture of pig iron in the electric furnace are iron ore, either hematite or magnetite, limestone and charcoal or coke. There is no choice as to the kind of iron ore, as the electric furnace will handle either hematite or magnetite. In regard to the limestone it is sometimes considered advisable to calcine the limestone before use in the electric furnace, to reduce the consumption of power which would be caused by the heat necessary to remove the carbon dioxide from the limestone in calcination, but the use of calcined limestone is not advisable because of the fine material added to the charge in this way. Charcoal is

preferable to coke in electric furnace manufacture of pig iron, because the energy consumption is less due to the possibility of use of the shaft type of furnace with charcoal, and operation of the furnace is more steady. Coke can be used, however, in the rectangular type of furnace without a high shaft.

Chinese iron ore appears to be the most available source of ore supply. There is plenty of iron ore of good grade in Southern California, but the freight rate

on it would prohibit its use, as it would be necessary to haul it several hundreds of miles by railroad before a water haul could be made. It is estimated that Chinese iron ore containing 60 per cent iron could be laid down at The Dalles at a cost of \$5 per ton. The iron ore necessary per ton of pig iron produced amounts to 16 tons, costing \$8.

From information at hand, it seems that the most available source of limestone is on Puget Sound. This could be laid down at The Dalles for about \$1.75 per ton. For the manufacture of pig iron in the shaft type of furnace this would not be calcined, as there would be too much dust formed, which causes hanging of



An Undeveloped Power Site in Oregon.

the charge in the furnace. About one quarter of a ton of limestone costing \$0.44 is required per ton of pig iron produced.

Charcoal or coke could be used as a reducing material. At the starting of a plant, charcoal would be the preferable material, but if the plant assumed great proportions, say requiring much over 100 tons of charcoal per day, we believe that it would be necessary to use coke, on account of possible scarcity of charcoal. It is estimated that charcoal could be laid down at The Dalles for about \$9 per short ton and coke for \$8 to \$11 per long ton, so that we will assume the cost of reducing agent as \$10 per long ton. About one-third of a ton of reducing agent would be necessary per ton of pig iron produced, which would cost \$3.33.

Labor requirements are the same as in blast furnace manufacture of pig iron, and a minimum wage of \$2.50 per day of eight hours is assumed.

Power. The power requirements are practically the same as in the manufacture of ferrosilicon. Power will be considered as costing at the furnaces \$11.70 per horsepower year, or 0.18 cents per kilowatt hour.

Cost of production. The estimate is based upon an annual production of 50,000 tons of pig iron. The plant would consist of five electric furnaces of 3500 horsepower each, the whole plant requiring 18,000 horsepower, including 500 horsepower for various uses outside of the furnaces.

Cost of Production of Pig Iron in the Electric Furnace at The Dalles, per long ton.

1.6 tons of iron ore at \$5 per long ton.....	\$ 8.00
0.33 long tons of charcoal or coke at \$10.....	3.33
0.25 long tons of limestone at \$1.75.....	0.44
10 lb. of carbon electrodes at 5 cents.....	0.50
2400 kw.-hr. at 0.18 cents.....	4.32
Labor	5.00
Maintenance and repairs.....	0.50
Amortization, depreciation at 5 per cent each.....	1.70
Interest at 6 per cent.....	1.02
General	1.40
Total	\$26.21

The cost of production of pig iron at The Dalles by use of the electric furnace would be about \$26 per long ton. As the market for this pig iron would be entirely upon the Pacific Coast, it could be sold f.o.b. plant. Laid down in Seattle or Portland or San Francisco, this pig iron would cost respectively, \$28, \$26.50 and \$30.50.

Market. The market for pig iron manufactured at The Dalles would be entirely upon the Pacific Coast and Canada. At the present time we do not believe that this market would be very great, due to the fact that with pig iron selling on the coast at from \$20 to \$25 per ton there is little incentive to use it in foundry work when scrap iron can be purchased at a much lower price. There is no large steel plant on the coast which would be a consumer of pig iron. Of course, with a production cost f.o.b. Dalles of \$26 per long ton, very little profit, if any, could be made on pig iron produced there, as the price ranges more around \$21 per ton f.o.b. San Francisco than it does around \$25.

Another important factor lies in the cheapness with which pig iron from England, China and India can be laid down upon the Pacific Coast. Pig iron from any of these countries could be delivered at Portland for from \$18 to \$20 per long ton. With the Panama

Canal open it is now possible to lay Eastern pig iron down on the Pacific Coast for about \$18 per long ton, so that the foreign or Eastern producer could undersell The Dalles manufacturer considerably.

Conclusions. The electric furnace manufacture of pig iron at The Dalles does not appear to be a feasible enterprise commercially, because of the high cost of product and market conditions. It would not be feasible commercially, either for sale of the pig iron as such or manufacture into steel at the plant because Eastern billet steel can be brought to the Pacific Coast at a total cost of \$30.50 per long ton, which would be much less than possible production at The Dalles.

The high cost of production is largely caused by the high cost of iron ore, which is about double that paid by Eastern blast furnaces which are producing pig iron for about \$10 per long ton; and also by the high labor cost which is about 70 per cent more expensive than Eastern labor. The cost of reducing material is also high as compared with the cost of Eastern coke at the furnaces, in spite of the fact that the electric furnace uses one-third of the amount of coke used by the blast furnace. It may be stated that the cost of production alone would be prohibitive of the success of an electric furnace pig iron industry at The Dalles.

To assure commercial success the plant should be able to sell its product in the coast market at as low a figure as \$18 per ton if necessary. Eastern or foreign pig iron can be laid down at that cost. Also, we do not believe the market for pig iron with the price as high as \$20 per ton will grow very rapidly, as it is cheaper to use scrap iron to make castings. For these reasons we do not feel that an enterprise manufacturing pig iron in the electric furnace at The Dalles would be financially successful.

Steel. There are two courses of procedure for steel manufacture in which the electric furnace has been used—cold scrap iron and steel of either inferior or high grade quality is melted and refined in an electric furnace with the production of steel of the highest grade equal to the best crucible steel; and molten steel, the product of either the acid or basic converters, or of the acid or basic open-hearth furnaces, is super-refined, or made into alloy steel, in an electric furnace. The steels thus made may be cast into ingots or various shapes. It has been proposed to use the electric furnace for the manufacture of steel from molten pig iron, but for use at The Dalles the cost would be prohibitive. The cost of any process using pig iron as a starting point at this place would be prohibitive, due to the high cost of pig iron, \$26 if made at the plant and at least \$20 if purchased from the East or foreign countries. Eastern steel at \$30.50 would control the market, for using the low cost of manufacture of steel in the East about \$8 per ton steel made from molten electric furnace pig iron would cost at least \$34 and probably over \$40, while that made out of Eastern pig iron which would have to be melted would cost at least \$30 and probably \$35.

As the high cost of pig iron prohibits the establishment of a tonnage steel plant, we will consider only an electric furnace plant for the production of high grade steel castings and shapes and bar steel.

Raw materials and labor. The principal raw material used in the electric furnace manufacture of steel

is scrap steel. While some scrap iron could be used, most of the material melted should be steel or wrought iron. Iron turnings, which in the open hearth are not especially desirable on account of oxidation losses, are about the most adaptable material for use in the electric furnace. There is not the high oxidation loss in the electric furnace that there is in the open hearth. Any scrap material used in the electric furnace must be small in size because of difficulty in operation of a furnace on large scrap iron due to short circuits. Formerly 2500 to 3000 tons of scrap iron and steel were used in Portland per month, and in addition 60 to 100 tons of turnings were produced. A large part of the turnings go to waste at present, and could be obtained cheaply. It is estimated that there is about the same amount available in Seattle, four or five times as much in San Francisco, and two or three times this amount in Los Angeles. It is probable that there is enough scrap steel available for a production of 26,000 tons of steel per year. Considering that a large part of this could be purchased in Portland where there are no steel foundries, the average cost at The Dalles should not exceed \$15 per long ton.

Labor requirements are the same as in combustion furnace manufacture of steel.

Power. In the electric furnace manufacture of steel, electric energy is used at about the same voltage as in production of pig iron or ferro-alloys, but the electric steel furnace can not maintain as high a load factor as the electric iron smelting furnace or the ferro-alloy furnace. As it is necessary to transform the 11,000 volt current to 40 to 100 volts, a transformer and line loss of 5 per cent would occur. This, on the basis of 100 per cent load factor, would make the power cost \$10.52 per horsepower year at the furnace. Owing to the intermittent nature of the electric furnace process in steel manufacture, a load factor over 80 per cent could only be maintained with difficulty. The power cost would then be \$13.15 or 0.20 cents per kilowatt hour. If a lower rate were made on power, an electric steel furnace could use off-peak power to advantage on account of the intermittent nature of the process.

Cost of production. The estimate of cost of production of electric furnace steel at The Dalles is based upon an annual production of 25,000 tons and the utilization of 4000 horsepower. There are so many combinations of furnaces of different sizes with which a plant could be equipped that we will not attempt to specify them. The estimate is based upon steel cast into ingot form.

Cost of Production of Steel in the Electric Furnace at The Dalles, per long ton.

1.1 tons of scrap at \$15 per ton.....	\$16.50
Slag materials	1.00
Ferro-alloys	1.00
800 kw.-hr. at 0.20 cents.....	1.60
Labor	2.50
Maintenance and repairs.....	2.40
20 lb. of electrodes at 5 cents.....	1.00
Amortization, depreciation at 5 per cent each.....	1.50
Interest at 6 per cent.....	0.90
General	1.00
Royalty	0.50
Total	\$29.95

The cost of production of ingot steel in the electric furnace at The Dalles would be about \$30 per long ton. Adding freight rates to Portland, Seattle and San

Francisco, the cost at these places would be \$30.50, \$32 and \$34.50 for scrap iron and steel.

Market. There is very little market for billet and ingot steel on the Pacific Coast, and we do not believe that at the present time a tonnage steel plant manufacturing ingots for rails and heavy steel would be able to compete in the market with Eastern or foreign products. There is a considerable demand for small shapes on the Pacific Coast, and considerable steel is used in this manner. A plant casting into such steel shapes of its product would possibly be able to dispose of its product, but a large part of the steel shapes belong to machinery manufactured in the East, and most of this steel comes from the Eastern states.

Conclusions. We believe that under present market conditions, considering the cost of production, that the manufacture of electric furnace steel at The Dalles would not be profitable. As in the case of pig iron, steel in the form of ingots, billets, rails or structural shapes can be laid down so cheaply on the Pacific Coast from the Eastern states or foreign countries as to render profitable manufacture of this steel at The Dalles impossible. While a small electric furnace foundry, manufacturing special steel shapes and using 500 to 1000 horsepower, might be successful, it would not amount to much as a large scale producer. Tonnage steel cannot be made at a profit on the Pacific Coast at the present time, due to the high cost of production of pig iron, rendering a self contained iron and steel plant using either electric furnaces or combustion furnaces impossible, due to this high cost of production. Of course, as previously stated, the high cost of producing pig iron is largely due to the high cost and scarcity of a satisfactory reducing agent.

Copper. As stated previously in this report, the electric smelting of copper ores is entirely in the experimental stage. Before it can be practiced commercially much money and time must be spent on experimental work. While we believe it to be feasible under the best of conditions, the process is not in such a condition at the present time to warrant its use in a plant located a long distance from the source of ore supply, as would be the case at The Dalles. There are no available developed copper deposits whose ores could be smelted at The Dalles without paying a very high freight rate. We believe that when some of the Alaskan deposits have been more developed, electric copper smelting might prove profitable at The Dalles, as the ore in this case could be hauled largely by water. For the present, however, we do not believe an electric furnace plant for smelting of copper ores would prove successful at The Dalles. As the process itself is not fully developed, we do not consider it worth while to give cost figures.

Zinc. While electric smelting of zinc ores is more advanced than electric smelting of copper ores, it has not been yet proven to be a commercial success or in fact a technical success. Such being the case, it can not be seriously considered as a source of consumption for The Dalles power. Any ores used at this place would have to be hauled for a considerable distance by rail, from Idaho, California or Colorado, as there are no zinc ores in Oregon or Washington in any large quantity. With the process of electric zinc smelting

more fully developed, its use might be possible at The Dalles, but under present conditions we do not consider that such an enterprise would have much chance of commercial success. As in the case of copper, for the purpose of this report we do not consider the process enough developed to give cost data.

Conclusions as to the Market for Hydroelectric Power at The Dalles in Electrometallurgical Industries.

Our conclusions in regard to the market for hydroelectric power at The Dalles in electrometallurgical industries are summarized as follows:

(1) The market for hydroelectric power at The Dalles in electrometallurgical industries in general is not great, and under the best of present conditions as regards sale of this power the part consumed in electrometallurgical plants would be a very small proportion of the total possible development at The Dalles, which amounts to 300,000 horsepower of primary power.

(2) An aluminum could not be produced at The Dalles at much less than the low market price, we do not believe that an aluminum company operating there would be successful, with the possible exception of one of the established European or American companies; which has a market for its product. As such a company at the present time can make more money by manufacturing aluminum in the Eastern states near the ore and market, we do not believe that there will be much of a market for The Dalles power with such a company until all available Eastern water power sites have been utilized. A company manufacturing at The Dalles would have great difficulty in meeting Eastern market competition, and could not operate at a profit with aluminum below 18 cents per pound. Hence, we do not believe that there is any immediate market for Dalles power in the aluminum industry.

(3) Ferrosilicon could not be laid down in the Eastern market at a cost less than the present selling price, so that there is no market for power in the manufacture of ferrosilicon, although if ferrosilicon could be made at The Dalles at a profit, market conditions are such as to indicate a ready sale of the product.

(4) Ferrochrome could be made at a considerable profit in the electric furnace at The Dalles. The supply of this alloy in the United States is largely furnished by an Eastern company. While there would be strong competition for the sale of this material in the Eastern market, it is probable that a well managed company would succeed, and that there would be an ultimate market for 3000 horsepower in this industry at The Dalles, if such an industry was started on a small scale.

(5) In view of the estimated high cost of production at The Dalles and the small market for pig iron on the Pacific Coast at the present time, we do not believe an electric furnace pig iron plant would be successful financially at The Dalles, and so we do not believe that there is any possible market for Dalles power in this industry at present.

(6) Because of the estimated high cost of production of steel in a large tonnage quantity by the electric furnace process at The Dalles, there does not seem to be any chance for the development of a very large electric furnace steel industry at that place. For foundry work, however, the cost might be low enough

and result in the sale of 500 h.p. at the start, which ultimately might be increased to 2000 h.p.

(7) Electric copper smelting and electric zinc smelting are still in the experimental stage, so that there can be no large sale of power for this purpose. Also the ore supply is very distant, making the success of such an enterprise doubtful.

(8) Among all the electrometallurgical industries mentioned above, there does not appear to be a market for over 5000 h.p. for the proposed development of Columbia River power at The Dalles.

A national electric range campaign is planned by the Society of Electrical Development. It has been suggested that the Society direct its special efforts to the securing and publishing of data showing cost of cooking. It was shown that in over 2800 communities a cooking rate of 5c or lower is in existence. Of this number over 70 per cent are 4c or lower and 27 per cent 3c or lower. It is recognized that the rate must be 4c or less to be sufficiently attractive to the householder. The society will publish specific data on the desirability of range business and to aid in conducting range campaigns. It was proposed that the society issue a booklet on how to put on a range campaign. Considerable stress was laid upon the suggestion that central stations include cost of installation in their range prices. In other words, quoting prices with the range installed, thus avoiding selling the range and having to then argue out cost of installation. It was decided to appoint a special committee to take up in detail the plans for a national electric range campaign. This committee to meet at Chicago, May 22d, 3 p. m., which will be N. E. L. A. Convention registration day.

Lewiston, Idaho, wishes to encourage investment of capital and the people have protested against the city council accepting the services of an engineer who offered to obtain a reduction in current rates for a contingent fee. As the Portland Oregonian points out: "The attitude of the people in this case received hearty approval from the newspapers of Lewiston and Boise, which pointed out that stagnation in development of Idaho, as of other states in the Pacific Northwest, is due to the excesses to which regulation and taxation of corporations have been carried. Being denied a fair return on their capital, investors have blacklisted these states and people suffer through lack of development. It is high time that the people of Oregon as well as other Pacific states changed their attitude toward corporations to accord with the changed attitude of corporations toward them. Prosperity in the East is creating a vast supply of new capital. It will come here if we turn a deaf ear to schemers like the man who made the proposition to Lewiston. The anti-corporation cry will soon die if the politicians find it is unpopular. If we continue to heed it, this new capital will go to other states and other countries. It does not need to come here. The United States now has practically the only supply of capital available for the whole world, and the investor will put it anywhere in the United States, Europe, South America or other countries where he can get good interest and security. We can get it if we offer the same attractions.

WATER RIGHTS AS A LIABILITY.

The Railroad Commission of California, in analyzing the value of the San Joaquin Light & Power Corporation for rate making purposes, has developed the fact that, in competition with oil at less than seventy-five cents per barrel, water rights have a negative value. The following data are taken from the commission's decision as written by Commissioner Max Thelen under date of April 6, 1916

Mr. C. E. Grunsky presented as San Joaquin's Exhibit No. 25 an estimate of the cost of generating electric energy by means of the corporation's present hydroelectric system as compared with the cost of generating an equivalent amount of electric energy in an assumed main plant and auxiliary plant operated by steam generated from oil.

Referring to the hydroelectric system, Mr. Grunsky assumed the installation of Power House No. 2, which is to be located on the North Fork of the San Joaquin River with a capacity of 2000 kw. Adding this capacity to the present installed capacity of the San Joaquin Corporation's hydroelectric system, Mr. Grunsky reached a total of 27,350 kw. installed capacity, which he used in his computations with reference to the corporation's hydroelectric system. The output capacity of Mr. Grunsky's substitutional all-steam plant was taken to be 31,500 kilowatts, of which 26,500 kilowatts would be installed at Bakersfield, where oil can be had at a low cost, and 5000 kilowatts at Fresno, as a stand-by.

Mr. Grunsky's conclusion is that with oil at 53.2 cents per barrel at Bakersfield, the total annual cost of operation, plus interest and depreciation, for the substitutional all-steam plant would be \$578,736, while the total annual cost of operation, plus interest and depreciation, for an equivalent amount of electric energy generated by the San Joaquin Corporation's present hydroelectric system, assuming that proposed Power House No. 2 has been completed and is in service, would be \$637,912. It thus appears on Mr. Grunsky's own figures that the annual expense in connection with the San Joaquin Corporation's hydroelectric system would be \$59,176 in excess of the expense of the assumed substitutional all-steam plant. If this sum is capitalized at 8 per cent, it will thus appear that the San Joaquin Corporation's hydroelectric system, when Power House No. 2 on the North Fork of the San Joaquin River has been completed and is in operation, will have a negative value of \$739,700 when oil costs 53.2 cents per barrel at Bakersfield. The prevailing price of oil at Bakersfield has been approximately 50 cents per barrel. Mr. Grunsky estimates that the annual cost of operating his substitutional all-steam plant, with auxiliary, will increase \$5,667 for each one cent increase in the price per barrel of oil at Bakersfield. He reaches the following conclusion with reference to the relative cost of operating the San Joaquin Corporation's hydroelectric system and the assumed substitutional all-steam systems, with oil at varying prices per barrel at Bakersfield:

TABLE NO. XI.

Relative Cost of Operating Hydroelectric System and Substitutional Steam System with Varying Prices of Oil at Bakersfield, as computed by C. E. Grunsky.

Price of Oil.	Operating cost plus 8 per cent interest and depreciation.		Hydroelectric Plant.		All-steam Plant.	
	Total annual.	Per kilowatt hour.	Total annual.	Per kilowatt hour.	Total annual.	Per kilowatt hour.
60c per bbl....	\$633,624		\$00560		\$560,602	\$0.00495
53.2c per bbl....	637,912		.00562		578,736	.00510
55c per bbl....	640,324		.00565		588,937	.00519
60c per bbl....	647,024		.00571		617,272	.00544
65c per bbl....	653,724		.00576		645,607	.00569
67c per bbl....	.....		.00578		.....	.00579
70c per bbl....	660,421		.00582		673,942	.00594
75c per bbl....	667,124		.00588		702,277	.00619

Mr. Grunsky concludes that with each advance of one cent per barrel in the price of oil at Bakersfield above 67 cents, there would be an advantage in favor of the hydroelectric plant of \$4,327 per annum. In making his comparison, Mr. Grunsky confined himself to production costs and did not consider transmission costs, for the reason that he concluded that transmission costs would be substantially the same whether the power be generated by water in the mountains or by an all-steam plant at Bakersfield, with an auxiliary at Fresno.

Mr. Grunsky concludes that the negative value of the San Joaquin Corporation's hydroelectric system at prevailing prices for oil at Bakersfield should not be taken as reflecting upon the business judgment of those who have initiated and carried forward the enterprise of developing the water powers of the San Joaquin, Kern and Tule rivers. He is of the opinion that no deduction should be made from the value of the San Joaquin Corporation's physical properties, by reason of the fact that under existing conditions the corporation's hydroelectric system shows a negative value as contrasted with the possibility of generating an equivalent amount of electric energy by steam.

G. R. Kenny, statistician of the San Joaquin Corporation, presented as corporation Exhibit No. 26, an estimate of the value of two of the corporation's water rights, singly and consolidated, on the comparative steam plant theory but on assumptions different from those used by Mr. Grunsky. Mr. Kenny confined his computations to the water rights in connection with the North Fork of the San Joaquin River and the Kern River, leaving out of consideration the Tule River and the Merced Falls developments. He differed further from Mr. Grunsky in that he assumed an installation of 7500 kw. on the Kern River, whereas the present installation, used by Mr. Grunsky, is only 1350 kw. Mr. Kenny assumed a substitutional steam plant with a capacity of 25,000 kw., located at Bakersfield, with a reserve steam plant of 5000 kw. located at Fresno. Mr. Kenny's conclusions with reference to the value of these two water rights of the San Joaquin Corporation, singly and combined, on the bases used by him, appear in the following:

TABLE NO. XII.

Water Right Values of North Fork and Kern Canyon Developments at Varying Prices of Oil at Bakersfield, Computed by Mr. G. R. Kenny.

Price of Oil.	North Fork.	Kern Canyon.	Total.	Combination.
50 cents.....	\$ 5,689.75	\$1,057,210.37	\$1,062,900.12	\$1,067,335.25
55 cents.....	180,663.50	1,170,909.12	1,351,572.62	1,374,216.25
60 cents.....	355,637.25	1,284,607.87	1,640,245.12	1,681,097.25
65 cents.....	530,611.00	1,398,306.62	1,928,917.62	1,987,978.25
70 cents.....	705,584.75	1,512,005.37	2,217,590.12	2,294,869.25
75 cents.....	880,558.50	1,625,704.12	2,506,262.62	2,601,740.25

It will be observed that Mr. Grunsky and Mr. Kenny both used the substitutional steam plant

method, but that one engineer, using this method, reports a large affirmative value for the corporation's water rights, while the other using the same method, reports a large negative value. As going to the reliability of this method of ascertaining the value of water rights for the generation of hydroelectric energy, the following table will be interesting. The deficits shown in Mr. Grunsky's report are capitalized at 8 per cent per annum, in order to make his conclusions comparable with those of Mr. Kenny:

TABLE NO. XIII.

Comparative Conclusions of Grunsky and Kenny with Reference to Value of Water Rights of San Joaquin Corporation, on Comparative Steam Method.

Price of Oil.	Combined Developments.		Difference.
	Kenny.	Grunsky.	
50c per bbl.....	+\$1,067,335.25	—\$912,775.00	\$1,980,110.25
55c per bbl.....	1,374,216.25	—642,337.50	2,016,553.75
60c per bbl.....	1,681,097.25	—371,900.00	2,052,997.25
65c per bbl.....	1,987,978.25	—101,462.50	2,089,440.75
70c per bbl.....	2,294,859.25	—168,978.00	2,125,884.25
75c per bbl.....	2,601,740.25	—439,412.50	2,162,327.75

In the foregoing computation the sign + means affirmative value, and the sign — means negative value.

It will be unnecessary for me to say that any theory which produces such strikingly dissimilar results, is open to the most serious question. If it were necessary to do so, attention might also be drawn to the unreliability of a theory which results in such varying water right values, shifting month by month and year by year with the varying prices of fuel oil and making the continuance of a stable rate base impossible.

Attention should here be drawn to the fact that the cost of production of hydroelectric energy assumed by Mr. Kenny in the foregoing computations is far less than the cost of producing hydroelectric energy assumed by the corporation in its cost of service computations as the basis for the establishment of rates in these proceedings. If it is fair to use a far lower cost of service in determining so-called water right values where the comparative plant theory is used, it would seem unfair to charge the public with any greater cost of producing power, when the cost of service computations on which rates are to be based are made. Mr. Kenny's estimate of the annual cost of production and transmission from the combined North Fork and Kern developments is \$646,036.44. On the other hand, the utility claims that the actual cost of service for the comparable items, to be used by this commission in establishing rates, is \$882,102.41. The following table shows a comparison of the cost of service estimates as presented by the San Joaquin Corporation in its Exhibit No. 27, and in its water right and comparative steam plant computations shown in its Exhibit No. 26:

TABLE NO. XIV.

Comparative Costs of Service Claimed by San Joaquin Light & Power Corporation as Between Cost of Service for Establishing Rates and Cost of Service for Establishing Water Right Values.

Estimated production and transmission cost, under present conditions, as shown by corporation's Exhibit No. 27.....	\$882,102.41
Estimated cost of combined hydroelectric developments, as shown by corporation's Exhibit No. 26..	646,036.44
Comparative substitutional steam plant cost, as shown by corporation's Exhibit No. 26.....	731,423.26
Excessive present cost over steam cost.....	150,679.15
Excessive present cost over combination hydroelectric cost	236,065.97

The foregoing estimates of cost are based upon the present demand and output and can therefore be considered as directly comparable. From the foregoing table it appears that the present cost of service

claimed by the corporation in its Exhibit No. 27, as the basis for establishing rates in these proceedings, is \$150,679.15 in excess of the substitutional steam plant referred to in the corporation's Exhibit No. 26, and \$236,065.97 in excess of the combined hydroelectric plants likewise referred to in the corporation's Exhibit No. 26. In other words, comparing Exhibit No. 26 of San Joaquin Light & Power Corporation with Exhibit No. 27, it would appear that the present installation of the corporation is extremely uneconomical. Capitalizing the excess cost, as claimed, of the present system over the cost of a substitutional steam plant at 8 per cent, it would appear that the present system has a negative value of \$1,883,489 when the cost of fuel at Bakersfield is 50 cents per barrel. This value will remain negative, on this basis, even if the price of oil should be increased to 75 cents per barrel.

As already indicated, Mr. Kenny assumed the construction and operation of two hydroelectric plants which are not now in existence, one a 2000 kw. plant, to be located on the North Fork of the San Joaquin River, and the other a 7500 kw. plant, to be installed on the Kern River in lieu of the present 1350 kw. plant. The importance of this one element in the problem is shown by the fact that with oil at 50 cents per barrel at Bakersfield, the present development on the Kern River Canyon would show, under Mr. Kenny's figures, a value for water rights of only \$151,191.50, as contrasted with the figure of \$1,057,210.37 appearing in Table No. XII and based on an assumed development of 7500 kilowatts. This 7500 kilowatt plant is not in existence, and there is no definite evidence in the record as to when it will be built. I assume that it will be quite generally agreed that in determining the value of the water rights of the San Joaquin Corporation, consideration should be given only to the present development or to such additional development as can be confidently counted on for the near future.

Mr. Kenny, as already pointed out, has considered only the developments on the North Fork of the San Joaquin River and on the Kern River, which developments the San Joaquin Corporation apparently assumed might show an affirmative value. The corporation has entirely left out of its computations the Tule River development and the Merced Falls development, which developments, under the corporation's own theory, admittedly show a negative value. It is obviously improper when seeking to ascertain the value of a utility's water rights for the generation of hydroelectric energy, to consider only those portions of the utility's hydroelectric development which seem to show an affirmative value and to leave out of consideration entirely those developments which would show a negative value. The value of a utility's water rights should be ascertained only from a consideration of the utility's entire water system used and useful in its business. For these reasons, the computations presented by Mr. Grunsky are entitled to greater consideration herein than those presented by the San Joaquin Corporation's own employees.

In order to ascertain the result of the comparative steam plant method when properly applied to the facts of these proceedings, the commission has made an independent computation. The following table

shows the cost of generating hydroelectric energy in the San Joaquin Corporation's present system, based on the electric energy sold in the year 1914, not including general and administrative expenses and taxes:

TABLE NO. XV.

Water Right Valuation—San Joaquin Light & Power Corporation's Present System.

Capital—	
Production capital:	
Crane Valley reservoir.....	\$1,177,044.56
Power plants	3,389,538.70
Total	\$4,566,583.26
Proportion of transmission capital:	
Production plant substation equipment	\$202,337.79
Transmission lines	202,068.82
	404,406.61
Total production and transmission.....	\$4,970,989.87
Estimated return—	
Interest at 8 per cent.....	397,679.18
Depreciation:	
Production	\$ 92,430.36
Transmission 22.965 per cent.....	14,454.00
	106,884.36
Expenses:	
Production	\$132,977.58
Transmission 22.965 per cent.....	8,208.13
	141,185.71
Total return, not including general administrative, etc., and taxes.....	\$645,749.26

In the foregoing table, the production capital and the estimated allowance for interest and depreciation have been taken from Mr. Kenny's report of the cost of service for the production system, as shown by Exhibit No. 27 of the San Joaquin Corporation. To the production capital has been added the estimated cost of power plant substation equipment and the cost of the transmission lines connecting the power plants with the main transmission lines, as shown in Railroad Commission's Exhibit No. 2. The transmission operating expenses and depreciation as reported by Mr. Kenny for 1914 have been prorated to this capital on the basis of relative investment. No general expenses or taxes have been included for comparative purposes. The Kenny values have been used in so far as possible.

The following table shows the cost of producing electric energy in two substitutional steam plants, one of which, with an installed capacity of 25,000 kw., is assumed to be located at Bakersfield, while the other, with an installed capacity of 5000 kw., to act as an auxiliary, is assumed to be located at Fresno:

TABLE NO. XVI.

Comparative Steam Plants at Bakersfield and Fresno, Cost of Production by Steam.

Main Plant.
25,000 kilowatts at Bakersfield.

Investment—	
25,000 kilowatts at \$50.....	\$1,250,000.00
Overhead 17½ per cent.....	218,750.00
	\$1,468,750.00
Substation equipment	146,750.00
Total	\$1,615,500.00
Estimated return—	
Interest at 8 per cent.....	\$129,240.00
Depreciation:	
Steam plant at 3.17 per cent.....	\$46,559.37
Substation at 3.62 per cent.....	5,313.00
	51,872.37
Operation (running expense):	
Steam plant expense, other than oil and supplies	\$41,418.44
Supplies	3,373.74
Substation expense	2,979.00
Fuel oil, 481,421 barrels at 50 cents.	240,710.50
	288,481.68
Total main plant.....	\$469,594.05

Auxiliary Plant.

5000 kilowatts at Fresno.

Investment—	
5000 kilowatts at \$50.....	\$350,000.00
Overhead 17½ per cent.....	43,750.00
	\$293,750.00
Substation equipment.....	29,350.00
Total	\$323,100.00
Estimated return—	
Interest at 8 per cent.....	\$25,848.00
Depreciation:	
Steam plant	\$9,311.87
Substation	1,062.00
	10,373.87
Operating expense:	
Steam plant expense other than oil..	\$9,000.00
Substation expense	595.00
Oil	13,500.00
	23,095.00
Total auxiliary plant.....	\$59,316.87
Total steam production (not including general expense or taxes)	\$528,910.92

It will be observed from the foregoing tables that while the cost of production in the comparative steam plants, not including general expense or taxes, would be \$528,910.92, the cost of production in the San Joaquin Corporation's present hydroelectric production system, is, on Mr. Kenny's computations with the necessary modifications, \$645,749.26, with oil at 50 cents per barrel at Bakersfield.

The total cost of fuel oil under the present system of the San Joaquin Corporation, taking an average of 1913 and 1914 was \$71,367.72. The cost of fuel oil in the comparative plant used in the commission's computations, assuming 50 cents per barrel at Bakersfield and 75 cents per barrel at the auxiliary plant at Fresno, would be \$254,210.50, or \$182,842.78 in excess of the actual consumption of the present system during 1913 and 1914. At 50 cents per barrel for oil at Bakersfield, the comparative plant would use 356,696 barrels of oil annually in excess of the existing plant. Hence it follows that for each 5 cents increased cost of oil at Bakersfield, the increase of the cost for the comparative steam plant would be \$17,834.70.

The following table shows the value of the water rights of the San Joaquin Corporation, on the commission's computations, with fuel oil at varying prices at Bakersfield. The results are all negative:

TABLE NO. XVII.

Value of Water Rights of San Joaquin Light & Power Corporation on Commission's Computations on Comparative Steam Plant Theory.

50c per bbl.....	— \$116,838.34	— \$1,450,479.00
55c per bbl.....	— 99,003.54	— 1,237,544.00
60c per bbl.....	— 81,168.74	— 1,014,609.00
65c per bbl.....	— 63,333.94	— 791,674.00
70c per bbl.....	— 45,499.19	— 568,739.00
75c per bbl.....	— 27,664.34	— 345,804.00

The sign — means a negative result.

The origin of California oil is ascribed by Robert Anderson and Robert W. Pack in Bulletin 603 of the U. S. Geological Survey to organic matter once contained in the myriad shells of minute sea organisms now found in certain shales associated with nearly every known California field. These organisms were both animal and vegetable, foraminifers and diatoms, which were entombed in ocean and buried under superimposed sediments. Earth movement, pressure and moderate heat probably contributed to the formation of oil which is stored in reservoirs made by adjacent pervious sandy strata.

MILITARY ENGINEERING.

BY CAPTAIN RICHARD PARK,
Corps of Engineers, U. S. Army.
(Concluded.)

Illuminating Devices.

We come now to the subject of field search lights, flares and other illuminating devices. Night operations were carried on by the Japanese in the Russo-Japanese war with wonderful success, clearly foreshadowing the extensive use that is being made of night attacks in the present war. It is apparent then that suitable measures must be taken to light up the foreground and obstacles at night. It is the duty of the military engineer to construct and operate all such devices. The most efficient lighting is furnished by electric searchlights of high power, but it is recognized that it would be practically impossible to provide enough searchlights to illuminate the foreground of hundreds of miles of trenches, so other means of illumination must be used in addition to searchlights. The simplest substitute is the bonfire. Materials for these should be placed close to the line of obstacles, and should be anchored to stakes in the ground to prevent them being torn apart and scattered by the enemy. They are fired as soon as the sentries in the entanglements report the advance of the enemy. Other illuminating devices are flares, rockets, and bombs. During the period of about a year and a half preceding the European war, many excellent devices were perfected of this class. The parachute rocket is discharged from a specially designed pistol or rifle, and has a long duration of burning, the parachute to which the rocket is attached opening at the instant of explosion and acting as a reflector. The rays of light are reflected downward, and the illuminated zone is considerable. Flares are manufactured in compact form and several of them can be carried on the person. Bombs are manufactured for artillery fire and designed to light up hostile trenches at considerable distances to the front. The short period of effective illumination afforded by any one of these small devices is a handicap, but due to their compactness and cheapness, as compared to searchlights, they can be fired in any quantity and by discharging a second rocket or flare just before the preceding one goes out any desired area can be kept illuminated as long as desired. These lights have one great advantage over searchlights in that it is practically impossible for the enemy to destroy the light itself or the source of power.

Small portable searchlights have been tried out in our army at the various maneuvers. These are usually sufficiently small as to permit one man to carry the projector and its standard, and one or two men or a pack mule to carry the generating outfit, which supplies the burner with oxy-gasoline, acetylene or other gaseous mixture. The projector throws out for a distance of from 50 to 100 yd. a restricted cone of light of considerable intensity. These devices have not so far been used by our army in actual warfare, but the engineers are hard at work devising proper equipment along these lines, and undoubtedly there are large numbers of the latest and most efficient types with the engineer troops in Mexico.

Searchlights were first used effectively by the Russians in the Russo-Japanese war, at Port Arthur. The

Russians used a great variety of steam boilers, engines and dynamos, and most of the lamps were apparently taken from the navy. They operated several lamps nightly and kept large areas of the foreground illuminated. They also used so-called star shells, being huge rockets filled with port fire which would illuminate the foreground for a few moments. The Japanese, however, had efficient portable field searchlight outfits using gasoline engines driving dynamos which supplied power for 90 cm. lamps. After their siege works reached points close to the defenders' works they apparently found little use for their lights. The Russo-Japanese war showed that night operations, especially against permanent fortifications, would be the rule in future wars, and foreign nations, as well as the United States, set about improving their searchlight outfits for use with the mobile troops. Our first field searchlight outfit was a steam operated plant devised and purchased in 1900, and could hardly be called portable.

Later the Navy designed some really portable outfits for use at advanced bases, and about the same time the coast artillery corps designed some along similar lines for use at seacoast forts. About 1909 the engineers supervised the design of and purchased two different types. One is a horse or mule drawn outfit of two units, a gasoline engine and generator in one vehicle, and a 30 in. searchlight with controller and power cable reels in another vehicle. The other outfit consisted of an automobile mounting a gasoline engine and generator. The truck was electric driven on the couple gear system, power being supplied to the wheel motors through a controller on the dash. The 30 in. searchlight was mounted on the two wheeled trailer and hauled behind the truck. There was sufficient power for the operation at one time of two 30 in. lamps. An additional 24 in. searchlight was designed to be operated from the top of a 40 ft. tower. The upper half of the tower telescopes with the lower half, which is hinged to the frame of a four wheeled wagon. For transportation the tower is lowered, turned back onto the wagon body, and the searchlight secured inside the framework.

Since 1910 the engineers have constantly been experimenting with a view to turning out the best possible portable outfits and there have been recently designed and put into commission several kinds involving the most modern features of foreign mobile searchlight outfits.

It is necessary that these outfits be designed and built in time of peace and that engineer officers and enlisted men be formed into searchlight companies and trained in their operation and repair. There is certain to be a need, in case the United States becomes involved in war with a foreign nation, for more searchlight outfits than will ever be provided for our army on a peace footing. At the end of a year's time a large number of outfits could be built in accordance with the latest models authorized as standard for the mobile army. In the meantime we would have to utilize such types of lamps and projectors of all candle-powers, and such generating outfits as could be improvised on short notice. There are a great many searchlights of various types in use throughout the United

States. These would be bought and mounted on small trucks. Small generating outfits could be improvised very quickly at the shops of our great electrical manufacturing concerns and also mounted on trucks. There is always on hand vast quantities of insulated wire, which would provide plenty of power cable. The operation or control of most of these searchlights would have to be by hand, since there is a scarcity of electric searchlights which are equipped with electric control devices. By control I mean the means used to turn the projector and therefore the searchlight beam from right to left and up and down.

For the operation, maintenance and repair of this improvised searchlight equipment, and also of the standard equipment that electrical concerns would be able to furnish by the end of a year's time, the Engineer Corps would need immediately upon the outbreak of war, a large force of electrical engineers. Neither the civil engineers nor the hydraulic engineers could help much in the operation of electric searchlights.

It is suggested that electrical engineers might organize in some way and offer their services to the War Department for enrollment not only with the searchlight companies or sections that would be formed at the outbreak of war, but also for service with the other arms where electrical devices and power are employed, such as the coast defense searchlights, the electrical maneuver devices of the great guns and mortars, or the light and power installations at seacoast batteries. They have the opportunity of seeing what we use in the way of electrical appliances at seacoast forts by going to seacoast forts and looking at them. They could seek and be given an opportunity to get instruction as to the way they are employed in the defense of cities. They should be given an opportunity to see what we have in the way of portable searchlight outfits for use in the field with mobile troops, and to learn their tactical employment in the attack and the defense.

It appears then that the basic engineering principles involved in the art of military engineering do not differ from those of civil engineering. In civil engineering, however, economy in cost is counted of greater importance than economy of time. In military engineering time is nearly always the most important point to be considered and any expense is justified that is found necessary for the speedy construction of a work which is necessary for success in battle, or the lack of which would bring disaster to our armies.

On the other hand, it will be apparent that the military engineer in addition to his knowledge of the engineering art must have a working knowledge of the art of war in all its phases, in order to apply his art in accordance with the tactical and strategical conditions involved. He must prepare the roads and other means of communication in such a way as to allow the rapid concentration of troops at their bases, or permit their swift advance to the attack. He must see that the camp sites are located properly and prepared with in view to giving the troops as much protection and rest as possible. He must select the sites for, and build the works that shelter the troops on the firing lines, and he is responsible that in the rear there are

adequate roads, suitably prepared for use to cover retreat.

Summing up, I have stated that engineer troops with the mobile army are charged with the following main duties: map making, the laying out of camps, road and bridge work, including the care and operation of the floating bridge equipage, maintenance and operation of military railroads, laying out and supervising the construction of field fortifications and siege works, including obstacles, and the maintenance and operation of electric searchlights and other illuminating devices.

For the performance of these many and varied duties engineer troops are provided for our army to the extent of 248 officers and 2000 enlisted men. There are 3 battalions of 4 companies each. One company is at Vancouver Barracks, 3 on the border, 1 in the Canal Zone, 1 in Hawaii, 2 in the Philippines, and 4 in Washington, D. C. The law recently passed increases the mobile army to its war strength of about 125,000. The engineers are not affected by this increase. The engineers then form less than 2 per cent of the total strength. This force is totally inadequate to handle the duties it would be called upon to undertake in a great war.

To the engineers in civil life, then, the army must look to supply the deficiency in trained engineer troops. In case of sudden outbreak of war great efforts will be made to secure by voluntary enlistment large numbers of men physically fit to march and to fire a rifle. Under present conditions it is certain that the service of many engineers would be lost to the technical branches of the army through enlistment in the infantry which always forms the bulk of armies. It is somebody's duty therefore to make the peace time arrangement necessary to insure that civilian engineers will be assigned in time of war to technical positions in the army. The Corps of Engineers will need the majority of these trained men but there are many duties in other branches where engineers are also necessary.

Army men are given no authority to initiate legislation, in fact regulations distinctly prohibit them from so doing. Such measures must then be initiated and pushed through by the civilian engineers who are free to propose and work up any adequate legislation.

As you know a bill has been introduced in Congress calling for the establishment of a Reserve Corps of Engineers, which provides for the giving of commissions for all grades up to that of major to those who demonstrate their fitness, these commissions to be renewable at discretion of the Secretary of War every five years.

This is assuredly a step in the right direction. Whatever is accomplished along these lines, civilian engineers may rest assured that the army engineers will assist them in carrying out the provisions of legislation in every way consistent with existing regulations governing their actions.

The pioneer battalions unmounted carry in addition to their engineers' outfit the complete infantry equipment. Each pioneer company has a mounted section of 24 men equipped as cavalry and accompanied by a demolition section mounted on mules. The pio-

neer battalions mounted carry in addition to their mounted engineering outfit, the complete cavalry equipment, and are of about the same strength as a cavalry squadron. All engineer officers with the mobile army are mounted.

The greater part of this paper has been devoted to explaining the technical duties of engineers with the mobile army.

The few remarks on organization and equipment are sufficient to show you that the engineer is also expected to march like the infantryman, to ride as a cavalryman, and on occasions to fight like both. In a swiftly moving campaign the technical duties of engineer troops may occupy 10 per cent of their time, 90 per cent of their time is taken up in being just soldiers like all the rest. During 90 per cent of their time they are occupied with the duty of getting where they are needed, when they are needed there. During 10 per cent of their time they are intensively applying on military engineering work their technical knowledge gained through long years of training.

You engineers have already acquired the technical knowledge necessary to enable you with a very little instruction to apply it to military engineering. By enrolling in the Engineer Corps of California you will get an idea of the value of military organization, and will also have the benefit of such lecture courses and study courses as the War Department may be willing to supply, with a view to giving you instruction in the application of your profession to military engineering.

A month at a business men's camp will give you some intensive field training, enough at least to convince you as to how little can be taught in a month, and how long a time is necessary to make one well trained for field service. You are already engineers, but in order to get where you will be needed when you are needed there, you must first, like the rest of us, be soldiers.

The Bell telephone system in Washington has been evaluated at \$12,009,281 by the Washington State Tax Commission, an increase of \$802,884 over the 1915 valuation.

An increase in municipal power rates has been ordered by the city council at Ellensburg, Wash., because of the inability of the plant to pay expenses. The Ellensburg plant has been run for several years on low rates and has been used as an advertising feature on the advantages of municipal ownership. The plant became buried under a monument of debt and the people of Ellensburg awoke to the fact that they have to charge higher prices or let the town go dark.

The legality of exclusive selling agreements has been ruled upon several times by the Federal Trade Commission, the decision invariably being that exclusive contracts are not unlawful unless they tend to cause monopoly. Neither the Federal Trade Commission Act nor the Clayton Act prohibits manufacturers from selling their product exclusively through one dealer in a given territory nor from denying the dealer permission to sell outside his assigned territory. The commission has not yet passed upon the question as to whether it is lawful for a seller to contract with his buyer not to sell the goods of another manufacturer.

SOME PROBLEMS OF INDUCTIVE INTERFERENCE.

(Concluded.)

L. T. Merwin: This looks like a slate—all here in a bunch and called on in rotation, and if it is I am going to attempt to break it. The spirit of co-operation should be rife here, particularly toward enlightening power men on the telephone man's troubles; and telephone men themselves should co-operate to intelligently inform the power men of their difficulties. There is a lot we power men do not know about the telephone business and it is possible that there are some things that the average telephone man does not know about the difficulties that beset an operating engineer with a power company. I feel quite lost when I go into the telephone building or the central exchange, and view the wonderful complexity of the equipment required for the handling of intelligence. I venture to say that the average telephone man would also feel just as much lost if suddenly put down in a modernly equipped steam-electric station and told to operate it. There is some contrast between the minute voltages and currents that the telephone man handles and the relatively tremendous currents and voltages of a modern electric station.

To break the slate—I want to ask a few questions of the telephone men—questions about things I want to know. All I know about telephony is what I have imbibed working with a little sixty-mile private telephone line that I had to make work. We simply had to talk to the power house from Portland and we couldn't. It was a puzzle to me. A telephone man would have put that line into shape in a jiffy and it would have been easy for him, but I am not in the telephone business. The power conductors, however, worked fine. I have heard them way over there on West Park and Alder street in the central exchange. Yes, the power conductors worked dandy, but the telephone simply would not. All I could get was a terrific roar, so I endeavored by hook or crook, blindly, to apply to the thing what the telephone people tell us must be done, namely transposition. Our power line and telephone conductors you understand, were already strung. In building the line we had to go through very rough country along the north bank of the Columbia and merely hit the high places so that our spans varied from 16 ft. to 1400 ft. Our conductor spacing varies from a 7 ft. triangle to a 7 ft. flat construction and then back again to a scalene triangle with a base of 15 ft. and an altitude of 6 ft. No two adjacent spans were the same for fifty miles due to the configuration of the ground, and you can imagine a mere power man trying to transpose in order to get a workable telephone with those power conductors now spraddling out and now coming in closer together as we hit the high places. It can't be done. At least I could not do it. Probably a telephone man could have accomplished it. The company was new and unlimited funds were not at my disposal but it was up to me to get that thing working. And it was in meeting and partially overcoming these difficulties that I came across and met the facts that brought me face to face with some of the difficulties the telephone man comes up against when it comes to the matter of interference from power lines. But now suppose the long distance telephone line of the Bell Company had been along the same side of the river with our lines on the north side. Suppose they had originally been on the north bank and we had desired to put our lines through there. I wonder if it is possible by mathematical analysis to have figured out a scheme of transposition that would have made the toll line usable. The chances are that the telephone people would have followed somewhat the route of the railroad along the north bank. They would have paralleled us from Camas up as far as White Salmon. In order to have maintained their standard spacing it would have been necessary for them to follow approximately the route of the railroad. We had to get our right-of-way wherever we could. Mr. Griswold would doubtless sing the praises of the rich farm lands of California but I want to tell you that there is no land held

so high in California as some of the rock piles we had to go over in getting our right-of-way. We had to take whatever we could get. The rocky points were high and irregular, so you see it is quite a complex parallelism.

Would it have been possible with our sort of a power line and spans to have figured out a scheme of transposition that would have fitted the case? Now, the power man, in this case myself, if you wish, would have had to take the telephone man's word for it that this could be done. He would say to me, "You put your transposition here—and here—and there—and another here—and put two in here," and so forth in that manner. Now, suppose that were done, would it solve the problem? Would it clear up the line? I don't know. I would have to take the telephone man's word for it. If he told me to do it and if he had a commission's power behind him which urged me on, I would have doubtless put them in just as he dictated. They would have gone in all right. Now, suppose we thought it had been worked out satisfactorily, and then after the first month's or day's operation they came around and said, "Put another transposition in here and one there and another one here, and it will be fine and dandy." Having done that we hope, of course, it would be fine and dandy. But maybe it would not, and then what?

Now this may be an exaggeration, but our line along the north bank of the Columbia River is in exceptionally rough country, and the solution of the whole problem and the overcoming of the difficulties of induction by transposition may be feasible and satisfactory to both parties, but I doubt it.

Now, from the power operators' standpoint, let me put another question. I ask for information. Let this represent the power house right here (indicating). Here is Camas eighteen miles from Portland across the river on the other side. A number of air break switches (indicating) at the Camas sub-station control the two towns of Camas and Washougal, and the Crown Willamette Paper Mill with a load of some 5000 h.p. Just outside the power house at White Salmon is another (indicating). At Stevenson is another. In Portland is another. We use the air break switches to facilitate the exact location of troubles when they come. Now, according to the California rules, the operation of these switches must follow the exact wishes of the communication companies. We could not operate any of these under any kind of load if it disturbed the transmission of intelligence and thus upsets the routine of community life. But here is a case:

Suddenly, while sitting in my office where I have the distinction of being the chief operator, load dispatcher, and a few other things, I hear a grunt downstairs in the steam plant and I know that there is trouble; that there is a disturbance on the lines, and soon I am notified that the high line is down, or say, that the high line is not down—but the telephone bell begins to ring most violently and unnecessarily, and I immediately know that there is trouble. I phone to Albina substation across the river and learn that we are still hanging on but that there is high voltage on the phone lines. The power house calls up in a hurry and so does my good friend, Mr. Hendrickson, at Washougal, who operates the Farmers' Co-operative Lines. He says to me, "You have put me out of business entirely." Probably Mr. Morden will get word from the Crown Willamette Mill that his lightning arresters are shooting over, and I come to the conclusion from all this that we must have an arcing ground on the line. Now, what do I do? There is no question but what the telephone companies are in a state of disturbance, for I again hear from Mr. Hendrickson and he informs me he is in an awful fix. The Farmers' lines coming in to his switchboard are grounded lines and you telephone men know that he is really in distress. What shall I do? I hastily get our local manager at Camas to the switching station and tell him to phone to the power house to take a certain amount of load—or drop a certain amount of load so that the load they generate would

be equivalent to the Crown Willamette demand and leave the Portland load on the Pittock station. Then, I tell him to open air break switch No. 3 at Camas and he reports switch No. 3 is open, and then we open our Portland switch and find Mr. Hendrickson is still in trouble and continues to call in. All right. We close here first, then we synchronize there, and I have this switch closed and that switch open and find that Hendrickson is fine and dandy, and have located the trouble somewhere between here and there (indicating). We have not interrupted the load of the Crown Willamette Mill, nor lost out in Portland, and we disturbed the communication circuits but a few minutes in certain local quarters.

Now, the thing of the California commission is, I believe not to disturb the channels of communication no matter what you do to your power line. But, in a spirit of fairness, I think any telephone man will admit that from the standpoint of the public it was just as important to maintain power service as it was to maintain the channels of intelligence. In this particular instance where the greatest disturbance was across the river in a sparsely settled community it was far more important to maintain power service than it would be to maintain in its integrity the channels of communication. But, the order of the Railroad Commission of California does not take into consideration the relative importance of these two things: the disturbance of the channels of communication, or the dropping of a power load. Now, I did the best I could. I probably broke two or three thousand k.v.a., wattless, in opening the switches and of course that temporarily interrupted the line or channels of intelligence.

Now, as to the charging of lightning arresters. Of course, the telephone men never have any troubles with road contractors interfering with their line by blasting operations, but we power men do, and in Washington where there has been quite a spasm of road building, we have suffered quite considerably. As a matter of fact, ninety per cent of our troubles since the line has been in operation has been due to indiscreet actions on the part of irrepressible road contractors. The other day out at Wind River, with the wind blowing very hard, blasting operations two hundred yards away from the line wafted a big root right across two of the conductors of the power line on a span where we had flat construction. The power house hung on its gates and tried to burn the obstruction off, a procedure not exactly approved by the telephone men but followed by power operators. Of course, I won't tell you what the average power station operator would say if he got an order: "Don't hang on there, you are interfering with Farmer Simpkins' telephone line at Washougal." He probably would hang right on. He would burn off the thing if he could, but in doing this, of course, he might cause other damage as was done in this particular instance with the lightning arresters at our Albina substation, breaking down the charging resistances and puncturing one stack of cones. Now, you know the cell films of electrolytic lightning arresters must be maintained, and so we had to make a makeshift connection to keep the others in service, even in crippled condition. This required frequent charging until the disabled stack was repaired. However, that would be directly against the order of the Railroad Commission of California. Lightning arresters must be charged, it says, at 2 a. m. or at sometime not here settled upon, but to be determined to the best interests of the telephone company, even at the expense of losing the balance of our arresters, that is, if this rule were strictly adhered to, but I really don't believe the telephone company would hold us to it. On a frank explanation and a statement of what the situation was they would say, "Go ahead and charge your arresters if absolutely necessary." But, I am speaking of the exact letter of the law; and under the ruling such a procedure would be unlawful.

Another point; in my haphazard investigation of this

(Concluded on page 347.)

JOURNAL OF ELECTRICITY

POWER AND GAS

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A certain nobleman went into a far country to receive for himself a kingdom, and to return.

The Parable of the Talents

And he called his servants and delivered unto each of them a talent, and said unto them, Occupy until I come.

And it came to pass, that when he was returned, having received the kingdom, then he commanded these servants to be called unto him that he might know how much every man had gained by trading.

Then came the first, saying, Lord thy talent hath gained ten talents.

And he said unto him, Well done, good and faithful servant; because thou hast been faithful in a very little, I will make thee ruler over much.

And the second came, saying, Lord, thy talent hath gained five talents.

And he said likewise to him, Well, thou good servant, thou hast been faithful in a few things, therefore have thou authority over many things.

And another came, saying, Lord, behold, here is thy talent which I have kept laid up in a napkin.

His Lord answered and said unto him, Thou wicked and slothful servant, thou oughtest to have put my money to the exchangers, and then at my coming I should have received my own with interest.

Take thou, therefore, the talent from him and give it unto him which hath ten talents. For unto everyone that hath shall be given, and he shall have abundance; but unto him that hath not shall be taken away even that which he hath.

Consider the federal bureau as the nobleman in the far country, the people of the Western states as the servants and the natural resources of the West as the talents. While certain of these servants would develop these resources for the benefit of all, others would keep them laid up in a napkin. Meanwhile the nobleman in the far country hath little understanding of conditions at home and chastiseth the faithful servant and maketh the slothful servant ruler over much.

Such, at least, is the way that the non-use of wasting water power looks to most of the Western people. The Pinchot conservationist, like an older brother to a younger, says we have spent our inheritance riotously, and therefore you should dig a hole in the earth and hide your inheritance away so that our children's children may enjoy it.

Waterpower, especially, is conserved only when used. Hoarding is wasting. Non-use is a wicked waste, not only of the waterpower, but of the fuel which is being needlessly used to do those things which might be done hydroelectrically. Over-production and lack of a market has made it possible to purchase fuel oil at Bakersfield, California at fifty cents a barrel. Assuming that four barrels of oil have the same heating value as one ton of coal, this price is equivalent to coal at two dollars a ton. Water power cannot compete with steam power on the basis of such an abnormally low fuel cost. Consequently, water power sites, today, are worth less than nothing, that is, they have a negative value, in accordance with the decision of the California Railroad Commission in the San Joaquin Light & Power Corporation rate case, as detailed elsewhere in these columns.

This state of affairs is temporary. The ultimate realization of the dream of "dollar oil" will, on the substitutional theory, convert water power liability into water power asset. But until conditions do change, there is no present profit in marketing hydro-

electric power in competition with steam-electric power made by squandering petroleum, which is invaluable as a source of gasoline and lubricating oils. Nearly half the entire crude oil production of this country is being foolishly burned under boilers and inefficiently used in the manufacture of artificial gas, whereas these duties can be better performed by electricity and the oil be available to cut down the high cost of gasoline and lubricating oils.

Ordinary common sense would seem to suggest that any man who is willing to expend energy and capital in developing water power that is now running idly to the sea should be encouraged as a real conservator of oil and timber. He might even be given a bonus for dedicating his ability and money to the public service.

But the Pinchotites do not see it in that light. They have been imbued with the false idea that water power is cheap. They look to an excise tax on hydro-electric plants as a means of raising needed revenue. They have hedged every possible power site with such hindrances as to effectually deter any would-be developers except those whose immediate necessities have forced them to terms.

Eight years ago this journal pointed out the inadequacy of the proposed Forest Service regulation as an aid to water power development. Then we were as a voice calling in the wilderness. Today, even the Forest Service officials admit the truth of our prophecy and seem willing to meet power company necessities half way.

But the muck-raker continues to prate about a water power trust robbing the people, public passion is inflamed and the problem seems little nearer to a solution than before it became a political issue. In the April number of "The World's Work," for example, appears a one-sided article whose author even accuses large corporations of resisting the alleged efforts of conservationists to open up the public domain!

In the meantime, oil-burning locomotives are inefficiently doing the duty of electric locomotives, irrigable lands are without water which might be electrically pumped and the natural growth of a vast region is being stunted. Surely some form of relief can be provided whereby the needs of the people can be protected and the rights of the investor assured.

An organization even stronger than that of the Prussian army, is gradually being built up in America by organized labor. Each was forced into existence by a dire necessity for defense. German weakness after the Franco-Prussian war was on a par with the plight of unorganized labor as being exploited by organized capital at about the same time. Consequently, common humanity sanctioned the building up of a German defense and the American public encouraged the organization of labor to get higher wages and shorter hours. Each was a defensive alliance.

But the change from a means of defense to one of offense is easy, the difference between armor and arms is slight. Furthermore, those owning offensive weapons are quick to take offense, if only to justify possession. So labor has recently assumed the offensive. For it not only appreciates its own strength but also

apprehends the weakness of capital as fettered by public regulation.

Capital was the first to be regulated because it was the first in its aggressions on the principles of democracy. Yet few people seem to be aware that the excesses of labor are now even a greater menace to the American ideal of equal rights to all than was ever offered by capital, nor do they perceive that the task of controlling labor will be far more difficult than that of regulating capital.

Labor has no property to be held as a hostage for good behavior, its leaders are irresponsible and the union is exempt from the supervision to which the rest of society is subject. Labor organizations are taught the doctrine of resistance to law, members are forbidden to join the National Guard and in England is the sad spectacle of workmen "trying to hold the arm of their native land when it is fighting for its life." In the United States the mine workers are planning to create a coal famine next winter, the railroad employes are arranging for a tie-up of transportation facilities this summer, and even now industrial workers are suspending manufacturing operations. And who are the real sufferers, if not the public?

There is much greater danger of the rise of special privilege and the fall of equal rights threatened by the dictatorship of a labor leader than was ever dreamed of by the deposed oligarchy of capital. National safety required that capital be prohibited from monopolizing any industry or public service without the strictest of regulation. Yet the perilous power to paralyze industry is trustingly to be placed in the hands of uncontrollable and irresponsible men if the recommendations of the Federal Industry Commission are adopted. This commission has given its approval to the right to strike, the right to boycott and the right to dictate terms of employment—all without the least restriction. Here is a threatened tyranny of labor that demands the action of an outraged public. Have the people any reason to believe that, in case the United States were at war, the coal miners, railway engineers or Westinghouse strikers would do otherwise than they are now doing? In time of peace, then let us prepare to handle such difficulties whenever they may arise.

Such preparation does not in any way involve the dissolution of the wonderful organization that has been built up by labor. But, like a fine piece of machinery it needs a governor to prevent its destroying itself in a frenzied burst of power. A clock without a regulator is no more useless than a labor federation without adequate means of public control.

In the peaceful providing of proper regulation let an oft-forgotten fact be remembered—the worker's economic interest lies with the employer he works with, rather than with the workers of concerns competing against his employer, and the employer's economic interest lies with his employe, rather than with rival employers. This identity of economic interest requires that the workers have a share in the profits and likewise stand ready to share in the losses. With the present intractability of labor such an ideal condition seems difficult of attainment. But education along proper lines, backed by the firm demand of an awakened public opinion will ultimately bring about its realization. Thus will the unity of interest cement the present diversity of aims.

The Menace of Uncontrolled Labor

PERSONALS

Harry Sayles, salesman for the Holabird-Reynolds Company, is at Los Angeles.

W. Brewster Hall of Pass & Seymour Co. has returned to San Francisco from Los Angeles.

W. D. Steele, vice-president of the Benjamin Electric Manufacturing Company, is at San Francisco.

S. Headman of the Power Equipment Company of San Francisco has returned from a short trip to Colusa.

C. V. Schneider, manager of the Electrical Supply Company of Sacramento, was at San Francisco this week.

Gerard Swope, vice-president and general sales manager of the Western Electric Company, is at San Francisco.

Allen Jones, sales engineer with the General Electric Company, has returned to San Francisco from Schenectady.

Clover Anderson, representative for the Electric Appliance Company in Oregon, is in San Francisco for a short stay.

B. J. Klein, Pacific Coast manager of the Bristol Instrument Company, has returned to San Francisco from Los Angeles.

H. P. Stow, following the death of F. J. Symmes of the Thos. Day Company of San Francisco, has been appointed general manager.

J. C. Hayes of the Hayes-Van Fleet Company, electrical dealers and contractors of Santa Rosa, spent a few days last week at San Francisco.

J. W. Thompson, electrical department of the H. W. Johns-Manville Company at Los Angeles, is spending three or four weeks at El Paso, Tex.

Harry Gall has been appointed general manager of the Douglas County Light & Water Company at Roseburg, Ore., succeeding C. R. Beese, resigned.

H. B. Kirkland, vice-president and general sales manager American Conduit Manufacturing Company of Pittsburgh, is at San Francisco for two weeks.

R. H. Coyne, Pacific Coast manager of the Kellogg Switchboard Supply Company, has returned to San Francisco after an extended trip throughout the Coast.

H. Havey, salesman with the Electric Appliance Company, has returned to San Francisco from a business trip to Nevada, where he reports business as flourishing.

F. S. Mills, formerly illuminating engineer at Los Angeles, has been made supervising engineer for the National X-Ray Reflector Co. and will establish offices at San Francisco and Los Angeles.

W. S. Greenfield, manager of the San Francisco and Los Angeles offices of the H. W. Johns-Manville Company, has returned to San Francisco from a short trip to Nevada and the Sacramento valley.

H. Kihara, electrical engineer of Talalta & Company of Tokyo, Japan, and N. Kishi, chief engineer of the Osaka Electric Light Company of Osaka, Japan, who have been touring the United States for the past two months, have returned to Japan.

George R. Murphy, Pacific Coast representative of the Electric Storage Battery Company of Philadelphia, who has been for the past month in the northwestern territory, is expected to return to his home office at San Francisco about the first of the month.

Attila Norman, general manager of the Oregon Power Company, has been appointed chairman of the finance committee of the Eugene Chamber of Commerce, and F. E. McKenna, local manager of the Oregon Power Company at Coquille, Oregon, has been elected secretary and treasurer of the Ko Keel Klub.

George C. Mason, vice-president Hurley-Mason Company, Portland; Bert C. Ball, president and manager Willamette Iron & Steel Works, Portland; O. B. Coldwell, general superintendent Portland Railway, Light & Power Company, Portland; O. F. Stafford, professor of chemistry and director of the chemical laboratories University of Oregon, Eugene, and A. M. Swartley, bureau of mines and geology, Corvallis, have been appointed Oregon members of the National Industrial Survey by the Naval Consulting Board.

MEETING NOTICES.

Pacific Coast Railway Electric Club.

The club met at the West Alameda shops of the Southern Pacific Company on Friday evening, April 21st, and enjoyed a trip through the big shop, including lectures, demonstrations and workings of the suburban electric cars.

San Francisco Electrical Development and Jovian League.

President E. M. Cutting presided at the meeting of April 19th, for the first time in several weeks because of his absence in the east. Theo. Dredge, as chairman of the day, carried out the military spirit of the meeting by means of a bugler who sounded the several calls preliminary to introducing Col. E. P. Mathewson, who gave an interesting talk on "Preparedness," with special reference to the National Guard. The league accepted an invitation to visit the local armory and inspect the artillery equipment.

Utah Society of Engineers.

The Utah Society of Engineers held their annual banquet and election of officers in the supper room of the Hotel Utah, Wednesday, April 19. Guy Sterling, a well known Salt Lake civil and mining engineer, was elected president; C. J. Ulrich, vice-president; W. A. Wilson, second vice-president; Hugh C. Lewis, secretary, and R. B. Ketchum, member of the executive committee. Eighty members were in attendance at the banquet. W. C. Ebaugh presided as toastmaster. Heber M. Wells, city commissioner, responded to the toast "Municipal Problems," in which he outlined the importance of the engineer in connection with the civic and industrial problems of municipality as well as in other walks of life. The Rev. Peter A. Simpkin responded to the toast "Eternal Engineering," which proved to be one of the most timely and interesting addresses ever given before this society. The members of the banquet committee were Fred Ulmer, John Jones, Frank W. Moore and S. S. Arentz.

Los Angeles Jovian League.

J. Harry Pieper, former president of the league and fourteenth Comus of the Jovian Order, presided at the meeting, April 19th, in the absence of President Holland. One hundred and sixty Jovians crowded the new banquet hall of Jahnke's cafe, to be gastronomically entertained and to listen to the witticisms of Matador Pieper, who never fails to make things interesting whenever he presides. The exchequer was considerably enriched by Pieper, who being no respecter of persons and exercising the authority of the chair to the limit, proceeded to fine the members in a most "scandalous" manner. However, it was done in such a clever and mirth-provoking way that it was greatly enjoyed by all. The money thus collected will be used to defray future program expense. After everything but car-fare had been extracted, the gavel was turned over to H. P. Hubbard, chairman of the day and master of ceremonies, who provided a fast and furious feast of fun and frolic in an entertainment which was away ahead of anything that has been given in the past. The College Inn Sextette—a company of very clever instrumentalists—and Master Eddie Van Schaik—"the McCormack of the Cafes"—were the principal attractions. Duke Stone, Ex-United States Prosecuting Attorney, made a short talk, relating some amusing stories and interesting experiences.

APPLICATIONS TO CALIFORNIA WATER COMMISSION.

Albert Givan of 1525 K street, Sacramento, has been granted a permit to appropriate 15 cu. ft. per sec. from the American River for the purpose of irrigation in the Carmichael Tract, also for fire protection and other domestic purposes. The water will be conducted to the colony by means of a pipe line $7\frac{1}{2}$ miles in length, the means of diversion being a pumping plant, with re-inforced concrete pumping station, with one twelve inch, eight inch and six inch electrically driven pumps. The land to be irrigated consists of 3100 acres and the estimated cost of the system is \$52,250.

The Blevins-Mallon Ditch Company of Colusa has been granted a permit to appropriate 42 cu. ft. per sec. of the waters of the Sacramento River, to be taken out at a point in the Jimeno Rancho near the northeast corner of the Clara Packer ranch and through a main canal two and a half miles in length, to be used in the irrigation of some 1800 acres of land in the above county. The water is to be lifted 17 ft. from the river into the main canal by a 24 in. centrifugal pump connected to a 125 h.p. electrically driven motor. The estimated cost of the system is \$11,000.

John F. Mauck of Calneva, Cal., has applied for permission to appropriate 120,000 acre-feet per annum of the waters of Honey Lake for irrigation purposes. In the application data are shown two main canals 22 miles in length to be known as the Triangle Ditch. There are no diversion works, the water to be pumped direct into the canal from the lake by means of a pumping system estimated to cost \$200,000. The canal at the headgate is 24 ft. wide at the water line and 20 ft. on the bottom, with a fall of 4 in. per 1000 ft. At $1\frac{1}{2}$ miles from the headgate the canal is 15 ft. wide on top and 7 ft. on bottom with a depth of water of five feet. At this point the main canal separates into two divisions to be known as North and South canals. The estimated cost of the ditches and canals is \$400,000.

Wm. L. Wales of Woodland has applied for permission to appropriate 500 second feet of the waters of Willow Creek, tributary to the Susan River in Lassen county. The plans of the project are incomplete, any further than the applicant states that it is proposed to irrigate 50,000 acres of land, which would indicate a project of a million dollars or more in case it were perfected.

The Mojave Mutual Land & Water Company of San Francisco has applied for permission to appropriate all the water in Oak Creek watershed, including all of the waters of Oak Creek, Mill Creek, springs and all the run-off and flood waters, not less than 70 cu. ft. per second for purposes of irrigation. The application sets forth a ditch seven and one-half miles long to be known as the Mojave Plain ditch. There is a proposed dam 100 ft. high, 600 ft. on top and 300 ft. on bottom, built of concrete with wasteway around dam. There is a proposed storage capacity of 50,000 acre feet. The land to be irrigated consists of some 61,440 acres in Kern county and the estimated cost of the works is \$400,000.

The California Chief Development Company, care of Chas. P. Brooks, Salt Lake City, has applied for permission to appropriate five second feet of the waters of Owl Creek and Gray Eagle Tunnel in Placer county for mining and milling purposes. There is a diversion and storage dam of timber crib and loose rock, a pipe line three-eighths of a mile long, with a total fall to be utilized of 1000 ft., designed to produce 568 theoretical horsepower, by means of a Pelton wheel and dynamo unit. The water is to be returned to Owl Creek after use. The estimated cost of the works is \$20,000.

W. L. Wales of Woodland (as trustee for F. L. Rinker and others) of Calneva, has applied for permission to appropriate 500 cu. ft. per sec. from Susan River, tributary to Honey Lake, Lassen county for irrigation purposes. The proposed

diversion contemplates the irrigation of 50,000 acres of land. The same applicant has also made application for another diversion of 500 sec. ft. of the waters of Eagle Lake for the purpose of irrigating the same land.

M. L. Hazzard of Whittier, Los Angeles county, has applied for permission to appropriate 2000 sec. ft. of the waters of San Dimas canyon, tributary to San Gabriel River for the purpose of storing said waters to prevent destruction of property and for use in irrigation. In the proposed works there is a canal four miles long, a concrete diversion dam, a storage reservoir impounding 15,000 acre feet, the dam to be 130 ft. high, 550 ft. on top and 25 ft. at bottom, with a width on top of seven feet, said dam to be of the arch principle, concrete construction. The estimated cost of the works is \$350,000.

Leon Bly of 1350 Washington street, San Francisco, has applied for permission to appropriate waters of Balls Canyon Creek and Willow Creek tributary to the Susan River in Lassen county. The application asks for 50,000 acre ft. per annum to be stored on Balls Creek and 500 cu. ft. per second to be diverted from Willow Creek. There is a proposed canal 21 miles long connected with the project, further data of which is to be supplied. The lands to be irrigated are in the north end of Honey Lake Valley.

W. L. Wales of Woodland has applied for permission to appropriate 500 cu. ft. per sec. of the waters of Skee-daddle Creek, tributary to Duck Lake in Lassen county. The plans are not set forth in the application, any further than it states that it is proposed to irrigate 50,000 acres or land.

H. A. Unruh of Arcadia, Los Angeles county, has made application for permission to appropriate five cu. ft. per sec. of the waters of Santa Ana stream by means of a dam and water distributing system, at an estimated cost of \$30,000. It is intended to water some 1000 acres in the Santa Ana Tract of the City of Arcadia.

B. A. and A. A. Wilson and L. D. Fay of Lidell, Napa county, have applied for permission to appropriate $12\frac{1}{2}$ sec. ft. of the waters of James Creek, which sinks into Pope Valley, for purposes of power to be used at mines. The main flume which is one-third of a mile in length is called the Twin Peaks Canal. There is a proposed diversion dam, a total fall to be utilized of from 100 to 150 ft., generating about 10 theoretical horsepower at a cost of approximately \$500.

The West Side Irrigation District, with headquarters at Tracy, has just filed its application for permission to appropriate 225 cu. ft. per second of the waters of Old River, tributary to the San Joaquin River in San Joaquin county. This is one of the last steps in the effort of the farmers of that rich section of Central California to apply the water to their lands. The organization of the district under the state laws, was completed last October, after a long struggle on the part of the majority of the land owners of that district, much opposition having been met with as in the majority of similar cases. This will be one of the most modern and up-to-date districts in the United States when completed. At present there are about 12,000 acres included within the district, but ultimately about 6000 acres more will be added. The water will be raised into the ditches by means of an immense pumping plant of latest design. The estimated cost of the works is \$285,000. The district has asked the commission six months' time in which to file their complete data.

Leon Bly of 1350 Washington street, San Francisco, has applied for permission to appropriate 300 cu. ft. per second of the waters of Susan River, the diversion sought being the surplus and unappropriated water to be taken during high water season and conveyed through Pine Creek to Eagle Lake and there stored for irrigating lands in Honey Lake Valley.

ELECTRICAL LEAGUE BASEBALL.

Last Saturday, April 22d, marked the opening of the Electric League, composed of the following teams: Electric Appliance Co., Electric Railway & Manufacturers' Supply Co., General Electric Co., Pacific States Electric Co., Westinghouse Electric & Mfg. Co., and Western Electric Co.

The league has chosen as their official park, the grounds of the Ocean Shore Railroad Co., at Twelfth and Mission streets, San Francisco, where all of the league games will be played every Saturday afternoon.

To put the league on an independent financial basis the teams have arranged for a dance to be given Friday night, May 5th, at Maple Hall, Polk and California streets. The object of this dance is to raise money to pay the expenses of the league, and we are planning for a great jollification for all of the fans and their friends, and we know that all who attend will have "some time."

Following is a detailed report of the first games of the season: Electric Appliance Co. vs. Electric Railway Mfg. Supply Co. The game called at 2:50 p. m. opened with Ermsco in the field. The wind was blowing hard, which made it almost impossible for any of the pitchers to use any "stuff" at all. The result was that the game was a regular swatfest on both sides. However the game was very interesting from first to last, as both teams were running neck and neck every inning up to the seventh, when the Ermsco's took a lead of 5 runs. In the first of the ninth inning the Electric Appliance Co. made a rally of four runs and brought their score up to 10 runs, ending the game by the score of 10 to 13 in the Ermsco's favor. Tommy Morgan, the Appliance manager, played a very spectacular part in the game the last few innings, by knocking out a couple of two-baggers and then stealing home and instead of sliding for a close finish he turned a flip-flop over the catcher, and scored another run, which nearly saved the day for his team. A home run was made by both teams.

Following is the line-up of the two teams:

Elect. Ry. & Mfg. Sup. Co.

W. MarklePitcher
G. WintonCenter Field
*G. RossCenter Field
J. StewartCatcher
T. FinleyThird Base
R. RogersFirst Base
H. HerningLeft Field
H. BigelowShort Stop
E. LangSecond Base
R. KahnRight Field
*Took Winton's place in the first of 8th inning.

H. P. Royer, Manager.

Electric Appliance Co.

RandallLeft Field
JackShort Stop
†MorganShort Stop
KinnearThird Base
BarneyPitcher
LongfellowRight Field
GutfieldCatcher
VictorSecond Base
CharleyFirst Base
ErnestCenter Field
†MendelsonCenter Field
§LorenzoCenter Field

†Morgan Sub. for Jack
†Mendelson Sub. for Ernest.
§Lorenzo Sub. for Mendelson.
"Thommy" Morgan, Mgr.

Western Electric Co. vs. General Electric Co.

The Western Electric Company's baseball team defeated the General Electric team by a score of 2 to 1 in one of the most interesting games ever witnessed. The game went 8 innings without a score, the General scoring one run in the first half of the ninth inning and the Westerns scored two runs in their second half.

It was a well played game, hits being few and far between. Pitcher Steffens of the Western had the better of the duel, allowing only five hits, walking one and fanning nine. Nattinger of the Generals pitched a very good game, but weakened in the ninth, walking two and hitting two; he allowed six hits and fanned seven.

Western Electric Co.

BradfordCenter Field
LorgonSecond Base
DalyShort Stop
AlexanderThird Base
WelchRight Field
O'ConnellLeft Field
HowardFirst Base
CassidyCatcher
SteffensPitcher

P. A. Strong, Manager.

General Electric Co.

R. NattingerShort Stop
F. ToomeySecond, Right Field
M. JolimayCatcher
G. JolimayThird Base
F. FloodSecond, Right Field
L. CookFirst Base
F. ReaLeft Field
W. NattingerPitcher
C. CookCenter Field

F. Rea, Manager.

Pacific States Elec. Co. vs. Westinghouse Elec. & Mfg. Co.

This game was officially started when D. E. Harris of the Pacific States pitched the first ball over the plate. The game was a good one; full of exciting plays which allowed both pitchers to show the "stuff" they could put on the ball, as well as to give the fielders a chance to pull over a grandstand play once in a while. The Pacific States boys were very proud of their new uniforms, and the report is out that that is the reason they won the game from Westinghouse by a score of 9 to 7; but according to that dope, when the other teams get their uniforms there sure will be "some ball playing."

Dunbar of the Westinghouse pitched a very good game considering the fact that he says he has not played ball for five years, and he deserves credit for the team he has gotten together, for both teams played a good game.

Following is a lineup of the two teams:

Pacific States Elect Co.

DunningShort Stop
McChesneyLeft Field
KennedySecond Base
MarkowitzThird Base
O'ConnellPitcher
KahnFirst Base
LaneCatcher
KaiserRight Field
MaloneyCenter Field
R. J. WolfManager

Westinghouse Elec. & Mfg. Co.

MilburnSecond Base
AndersonFirst Base
GoldmanShort Stop
BagleyThird Base
GoldbeckCatcher
DunbarPitcher
WardLeft Field
HagenCenter Field
ChapmanRight Field
MerrillRight Field
W. R. DunbarManager

TRADE NOTES.

T. J. Hopkins has just opened up new offices in the Monadnock building, San Francisco, representing the Central Electric Company of Chicago on this Coast.

F. E. Newberry of San Francisco has secured the big contract for wiring the new building of the American Can Company on Twenty-second and Kentucky streets.

Ne Page & McKenny have secured the contract for the wiring and necessary equipment for the University of California library, Berkeley, amounting to approximately \$25,000.

H. S. Tittle, electrical contractor of San Francisco, is at Fort Huachuaco to be there for the final test on the new power station that his firm contracted for some time ago. The cost of the entire job was approximately \$75,000.

The Electric Construction Company of San Francisco has a wiring equipment contract from the Miller Estate Company, 300 North Fifteenth street, with 300 outlets and 100 switches. Also another contract at Eighth and Washington streets, 52 outlets and 8 switches, and 331 Walnut street, installing 10 fixtures.

The Pacific Coast Fire Extinguisher Company of San Francisco has recently closed a contract for the electrical installation on the new addition to the Ford Motor Car Company's building at Nineteenth and Harrison streets, as well as being the lowest bidder for the work for the recently renovated Lane Hospital.

UTAH-NEVADA AGRICULTURAL DEMONSTRATION TRAIN.

The agricultural colleges of Utah and Nevada, during the past month, have sent a demonstration train over the lines of the Salt Lake Route. This train consisted of ten cars electrically lighted, equipped and operated. The General Electric Co. exhibited a car fitted with generators, motors, ranges, heaters, washing machines and other electrically operated devices for the home and ranch. Fairbanks, Morse Company showed a line of electric and gas driven pumps and electric generators and motors. Others cars were equipped by agricultural implement companies. A beet sugar company and the government wool bureau also had cars. All meetings were largely attended and the demonstration is considered a success.

DISCUSSION ON INDUCTIVE INTERFERENCE ORDER.

(Continued from page 341.)

private line of ours a few things came to my attention, and I want to ask of the telephone men if it is not possible that some such procedure could be followed in the case of their toll lines. Have you made investigations for the elimination of inductive influence by means other than transposition? Have you experienced with devices that at the expense of increasing the attenuation of the talking voice you can practically obliterate at least the lower harmonics induced on your lines? Having done so can you not by means that are readily within your command, and that you are now using, amplify again the weakened or attenuated voice currents and bring them out with the absence of the previously disturbing harmonics? I want to ask you if you have followed some such procedure? It is exactly the method and the only method I have found available that made our own private line at all usable. By means of various complex combinations of shunts, I have succeeded in obliterating the fundamental, third, fifth and seventh and the ninth harmonics, although with the ninth and higher we are getting right near the range of maximum audibility and reduce by attenuation the talking voice. However, following the same course, can that be done? Is it possible? And again, is it possible that some device may be put on the line that will produce much greater attenuation with the lower induced frequencies than with the average voice frequencies in the region around eight hundred cycles per second? If that be possible, why not practically eliminate all the lower disturbing frequencies and then with your audion bulbs or other means of amplification bring out again the desired voice currents to any strength desired. My firm conviction is that this can be done and without excessive distortion of the voice currents. My own feeble attempts seem to show that it can be accomplished. But, what are you going to do with the eleventh, thirteenth and fifteenth harmonics? They come right at the point of maximum sensitiveness of the telephone receiver. I don't know. You might get into difficulties there. In my own investigations I did not find any such harmonics that were troublesome. I noticed that in the report of the investigating committee there were a number of these higher frequencies in some of the lines in California, even up to the thirty-seventh harmonic.

I notice, however, that the devices I have used will improve the natural talking voice. I have a Swede operator on the evening shift at the power house and he talks English in the usual manner of the Swede, and my device improves his natural speaking voice and he expresses himself much better and his voice sounds quite like an American by suppressing some of the lower frequencies. It really improves my conversation with him. As a matter of fact, I can understand him better now over our telephone line by suppressing those lower frequencies than I could if I had him in my office and talked to him face to face.

Now gentlemen, you can see from this, that I really know very little about telephony, but I do want to know and these things come up in the powermen's experience and we are all interested in these problems and in the possible solution of them; we want to know more about them, and if you telephone men would come to these meetings and tell us these things and talk over with us our mutual needs, we are going to get along together better and do better work for ourselves.

A. H. Griswold: In regard to Mr. Fiskens suggestion that "Inductive Interference" he studied by a national organization, I understand that such a procedure is already under way. Recently Paul Downing of the Pacific Gas & Electric Company, and H. A. Barre of the Pacific Light & Power Company were in the East, and while there interviewed Dr. Rosa of the Bureau of Standards. It was reported that Dr. Rosa expressed considerable enthusiasm with reference to a nation wide investigation of "Inductive Interference" by his

department, and that it was generally agreed that an appropriation of at least \$100,000 by Congress, or otherwise, was necessary in order to start the work.

It is not our intention in presenting tonight, the subject of inductive interference, to, in any way, bring in question the California rules, or to propose them for Oregon. We are simply endeavoring to tell you some of the things we have learned about inductive interference, so that we may meet each other face to face with our problems, and work them out together.

The nature of inductive interference is such that it is extremely difficult to establish specific working rules applying to all cases. It is therefore necessary to establish the fundamentals, and then from these fundamentals work out the solution for each particular case. For example, Mr. Nims asked for a definition of a parallel—that is very much like trying to answer the question, "How long is a piece of string?" I have known parallels of a few spans in length to create more trouble in telephone lines than Mr. Fiskens' parallel of ninety miles or more from Spokane to Wallace.

So, it is necessary to carefully determine the particular characteristics and pertinent factors of each parallel, and with these data at hand to determine the best solution for that particular case.

Another question raised by Mr. Nims was with reference to what he considered extreme measures required in connection with parallel power lines and farmer telephone lines. In reply I would call to Mr. Nims' attention the fact that the California order covers only long distance or toll telephone line, and therefore no remedial measures are provided for farmer lines. The case of Mr. Merwin is perhaps one of the most unique in the country. I doubt if you will find many places where the telephone line will be in the vicinity of such a power line. At least, there will be very few instances where the serious difficulties that were involved in that case, will arise. I wish to say further, and to admit very frankly, right now, that I doubt very much whether any telephone man, or the joint committee, would undertake to operate a commercial telephone line under such conditions, particularly if the telephone line and power line were in sufficient proximity to create harmful inductive interference, and the difficulties arising in connection with it so difficult to overcome from the inductive interference standpoint. I think, Mr. Merwin, we would be inclined to move across the river.

The question of devices to prevent or mitigate inductive interference was raised by some one. In answer I think we have investigated every device ever propounded on an unsuspecting public, and in addition we have done every reasonable thing known to art, to eliminate interference, before taking the matter up with the power companies. But it is almost inevitably found that the best, the most economical, and the most reasonable solution does not lie with the telephone lines alone, but rather by effecting certain changes with reference to both the telephone and power lines.

Mr. Fiskens stated that recently the telephone protecting devices had been found satisfactory for 7500 volts, instead of 500 volts. If that is true, we are happier than the power men; but, to date, the data which I have had has been the result of thousands of experiments on these protecting devices which have placed the safety limit at 5000 volts.

In closing I wish to state that while the solutions of inductive interference troubles have in the past, and may sometimes in the future, seem rather difficult, I know from past experience that if we will together look at each problem fairly and squarely with reference to the facts as they are, we will both be surprised and gratified at the comparative ease with which proper and efficient remedial measures can be obtained. All that we ask is that you meet us half way, tell us your troubles, just as we shall tell you our own, and from such a better mutual understanding only good to both of us and to the community at large, can result.



NEWS NOTES



INCORPORATIONS.

MAGDALENA, N. M.—The K. W. Light & Power Company of Magdalena has filed articles with the state corporation commission, with an authorized capital of \$50,000. The principal incorporators are George Keith of Magdalena and J. E. Wayne of Socorro and H. H. Lisle of Elmendorf.

MONTICELLO, N. M.—The Socorro-Sierra Telephone Company has been formed by W. G. Milligan and Joe Milligan of San Marcial, N. M., and Antonio T. Chavez and Edward Milligan of Monticello, N. M. The principal place of business is at Monticello.

RIALTO, CAL.—With a capitalization of \$350,000, the Fontana Power Company has been incorporated by A. B. Miller, J. C. Jones, R. H. Hassler, C. A. Stone and A. Wilson. The company expects to absorb the present Fontana water supply system. Power will be developed in the San Bernardino mountains and supply other localities about Fontana.

LOS ANGELES, CAL.—The Southern California Telephone Company has filed articles of incorporation with a capital stock of \$10,000,000. The purpose is to merge the Pacific Telephone & Telegraph Company and the Home Telephone Company in Southern California. The incorporators are J. G. Mott, R. J. Dillon, G. C. O'Connell, V. F. Collins, A. L. Rowland, C. H. Merrill and Arthur N. Gage.

ILLUMINATION.

NEWPORT BEACH, CAL.—This city has voted \$30,000 in bonds for the municipal distribution of natural gas.

LA CRESSE, WASH.—H. G. Wilson has received an electric lighting franchise and has begun the erection of his plant on Crystal street.

LOS ANGELES, CAL.—The board of supervisors has granted the request for the installation of additional lights in the Hawthorne Lighting District.

BERKELEY, CAL.—Several property owners have asked the council to form a lighting district east of Shattuck avenue and north of the University Campus.

LAKEPORT, CAL.—F. L. Wright, general manager of the California Telephone & Light Company, has been looking over the Lake County plant, making estimates of the cost of its reconstruction.

ROSEBURG, ORE.—An election will be held May 1st for the purpose of voting on the granting of an electric franchise to A. E. Brais. Mr. Brais proposes to establish electric light and power service in Riddle.

CASA GRANDE, ARIZ.—Plans for the proposed municipal light, power, ice and water works here, for the building of which \$30,000 bonds have been voted, have been prepared by City Engineer Sidney K. Mashbir.

RENO, NEV.—Incandescent street lights of 400 candle-power are to be installed in the residence section of Reno. The city council has authorized the Reno Power, Light & Water Company to proceed with the work.

SANTA ANA, CAL.—Plans for better street lighting include negotiations for replacing the incandescents now in use by new nitrogen lamps and for other changes. It is believed that at least four additional arc lights should be put in and that the lighting of outlying streets should be extended.

TRANSMISSION.

LOVELOCK, NEV.—The Nevada Valleys Power Company is considering the extension of its high tension transmission power line northward from Lovelock.

SPOKANE, WASH.—Negotiations are under way for the purchase of the electric plant of the Similkameen Power Company by Eugene Enloe of Spokane, representing the Okanogan Valley Power Company.

MONTESANO, WASH.—The purchase of the Elma Light & Power Company by the Northwest Electric & Water Works of Montesano, has been announced and the electric service of Montesano and Elma will be combined.

SALT LAKE CITY, UTAH.—The Utah Power & Light Company has purchased the municipal lighting plants at Wellsville and at Farmington, Utah and is now serving these towns under contract. The operation of both plants has been unprofitable to the municipalities.

NORTH YAKIMA, WASH.—The Pacific Power & Light Company has applied to the commissioners of Yakima county for a 50 year franchise to construct and operate electric power lines for electric light, telephone and telegraph purposes along the county roads. A hearing will be held May 1st.

LOS CRUCES, N. M.—The board of directors of the Water Users' Association has investigated the Leasburg hydroelectric power proposition and estimates have been prepared by engineers. The cost of construction, installation of machinery and a power line to Los Cruces will be approximately \$60,000.

BAKER, ORE.—The city council of Richland, Baker county, has granted a 20 year franchise to the Dry Gulch Ditch Company to construct and maintain an electric lighting system. The company will develop power from Eagle River and it is announced will be ready to serve Richmond and a portion of Eagle valley by the first of October.

LOS ANGELES, CAL.—A resolution has been adopted by the city council declaring that it is necessary for municipal purposes, and that public necessity requires that a permanent easement and right-of-way be acquired for the purpose of constructing electric power transmission lines and telephone lines extending from a point in Inyo county to a point in Los Angeles county.

SAN FRANCISCO, CAL.—The Great Western Power Company and the Pacific Gas & Electric Company have arranged for the joint use of poles on Clement street from Arguello boulevard to Twenty-fifth avenue. The Great Western Company is to erect poles 60 ft. high, large enough to carry the wires of several companies, and will transfer to them the wires of the Pacific Gas & Electric Company, which will then remove its small poles.

TELEPHONE AND TELEGRAPH.

VALLEJO, CAL.—A 25 year franchise has been granted the Pacific Telephone & Telegraph Company. The city is to receive 2 per cent of the company's gross receipts from business.

PASCO, WASH.—David C. Jeff, D. W. Jeff and W. O. Rogers have made application to the commissioners of Franklin county for permission to maintain a telephone system over the Pasco and Rattlesnake roads.

OXNARD, CAL.—At a meeting of the board of trade the proposed consolidation of the two telephone companies here were discussed. C. J. Elliott, R. B. Whitman and Ed. Abplanalp were appointed as a committee to meet the local managers of the companies.

MANSFIELD, WASH.—Al. Rogers has presented a proposition to the business men whereby the Farmers' Independent Telephone Company will give a 24 hour service and a direct toll line to the county seat. If sufficient business can be secured, the line will be built.

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DEVELOPING ELECTRIC RANGE AND HEATING BUSINESS.

BY E. A. WILCOX.

PARALLEL OPERATION OF ALTERNATORS.

BY L. J. CORBETT.

THE MEDLOW DAM.

BY PERCY ALLAN.

CRITICISM OF FERRIS BILL.

BY C. C. CHAPMAN.

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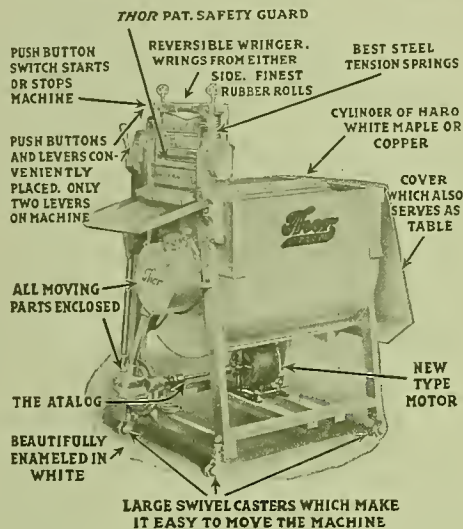
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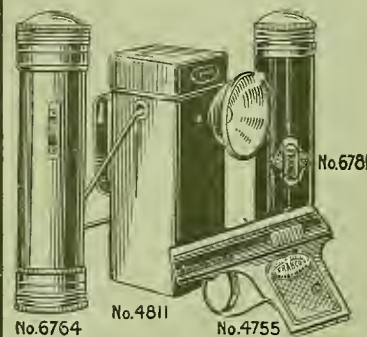
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DEVELOPING ELECTRIC RANGE AND HEATING BUSINESS

BY E. A. WILCOX.

The introduction of electric ranges in the territory served by the Great Western Power Company of California has been carried on quietly but effectively by its sales department during the past twelve months. No special sales campaign was instituted when the work of placing ranges in the consumer's homes was undertaken. The regular members of the sales force were supplied with general information on electric cooking,

apparent among all the employees and the salesmen have lists of many satisfied customers and records of energy consumption to which prospective users may be referred.

Profiting by its experience and the advantages gained during the past year, the Great Western Power Company has decided upon the expenditure of certain sums and the establishment of a general policy for pro-



San Francisco Electric Range Display Rooms of Great Western Power Co.

asked to familiarize themselves with it, and instructed how to sell ranges.

The results of the effort so far expended have been very satisfactory. Whereas there were less than 20 ranges in satisfactory operation on the entire system a year ago there are now over 400 ranges in successful service. Furthermore, a corps of salesmen has been trained to know the best methods of selling ranges and the interest of the men in every department has been created and their confidence established in the substantial nature of the business.

Reviewing the progress that has been made and the manner in which the work was undertaken, it is apparent that effort has been well directed. Had an elaborate and expensive campaign been instituted a year ago many mistakes might have been made, inaccurate advice given, and less efficient service rendered than is possible with the trained salesmen and service men now engaged in the work. At the present time confidence in and knowledge of electric cooking is

moting the sale of ranges during the ensuing season. As in other matters pertaining to the management and general policy of the company, W. W. Briggs, general agent, is directing the activities of the range department and giving it his careful thought and attention. A mark has been set by Mr. Briggs for the sale of 1400 ranges during the six months' period succeeding May 1, 1916, and present indications are that this figure may even be exceeded.

The development of the range business has naturally expanded into the sale of water heaters, bake ovens, and various industrial heating and cooking devices. Approximately 160 water heaters are now in use on the company's lines. Eight electric bake ovens of various sizes have been placed in service in cafeterias and small bakeries. A new 500 loaf oven, one of the largest ever manufactured, is being installed in Sacramento. The electric cafeteria in Sacramento, which operates entirely by electricity and has a connected load of 119 kw., is another industrial application re-

sulting from interest created by the development of the domestic range business. Other industrial heating installations, including enameling furnaces, drying ovens, welding machines, metal melting pots, etc., are being installed.

In line with the present active effort being put forth on the introduction of electric ranges, water heaters and other heating devices, display rooms have been opened in several of the districts. As the central offices of the company in San Francisco were found to be of too small capacity to afford adequate display room facilities, quarters were finally secured near one of the prominent corners in the city's downtown shopping district. These new quarters, consisting of a first and second floor in the Press Club building, have been elegantly fitted up and are probably as completely equipped as any power company's sales rooms in the country, utilized exclusively for electric ranges and heating device displays.

The main portion of the new display rooms, or exposition quarters, as they would be more appropriately named, is on the second floor and is reached by a stairway or an elevator. On this floor practically all the modern makes of electric ranges in various styles are on exhibition. The space provided is 80 ft. long and 20 ft. wide. The polished floors, light colored walls and ceilings, large windows, semi-indirect lighting fixtures and modern furnishings combine to make the room exceedingly attractive. Heavy baseboard plugs are arranged around the room to permit the connecting and demonstrating of ranges as desired. A complete electric kitchen has been fitted up in one corner to show the housewife how her own home workshop would appear with modern convenient labor saving devices installed. Other portions of the room are provided with tables, chairs and rugs so as to present the appearance of a rest room. Full sets of dishes are available and it is planned to serve tea during the afternoons. Miss Elizabeth Holmes is in charge of the display room and acts as hostess to the visitors.

The front part of the first floor is arranged for display purposes and the back portion for office space. The display window has been fitted up especially for exhibiting ranges and attracting prospective purchasers. Flood lights are mounted above the window. The arrangement and trimmings are changed and different makes and styles of ranges placed in the window regularly.

Of particular interest is a model electric water-heater which has been installed in an out-of-the-way corner of the electric kitchen. This equipment consists of an ordinary 30 gallon kitchen boiler which has been converted to the most efficient type of electric water-heater by merely removing the side and bottom water-back connections and respectively inserting a specially designed thermostat and a 1500-watt heating element. To complete this simple conversion, a standard hair-felt boiler cover is laced around the tank, covering it top and bottom, which conserves the stored heat and holds available for use at any hour of the day or night 30 gallons of water heated to the temperature at which the thermostat is adjusted to operate.

To check in detail the operation of this water-heater, the visitor's attention is directed to a meter-board upon which is mounted a watthour meter show-

ing the actual energy consumption and corresponding operating cost; a water meter showing the boiler input, and a graphic thermometer connected to the top of the tank showing how perfect is the temperature control of the water leaving the tank, whether one or thirty gallons are drained from the boiler. Direct reading thermometers are also inserted at the top, bottom and middle of the tank, indicating the temperature of the water at different levels in the boiler, and clearly demonstrating the perfect circulation effected by the specially designed immersion heater.

It is needless to remark on the interest that has been displayed by visitors in this electric water-heater, which has a thermal control capable of adjustment to operate at any temperature between 75 and 175 degrees Fahrenheit. These heaters, equipped with a thermostat and adaptable for insertion in any standard household boiler, are being manufactured by the Electric Sales-Service Company of San Francisco.

The thermostat, though extremely simple, is a scientific instrument and has a record of three years' continuous operation without an adjustment, in maintaining temperatures to an accuracy of half a degree.

The most novel feature of the installation, aside from its life-long guarantee, however, is the design of the heating element, which is built up in six or more sections of 250 watts each. Each section is separately controlled by the thermostat and the regulation is such that the individual units are consecutively cut on and cut off the service line one at a time, at intervals of about one minute, as the temperature of the water passes below or above that point at which the thermostat happens to be set.

By reducing the instantaneous increase in demand to a minimum of 250 watts, regardless as to whether the total capacity is 1000, 2000 or 3000 watts, the multiple control prevents any disturbance to the residence power circuits, such as blinking the lights, which effect may often be noted in the case of even a 500-watt electric iron.

This type of heater is as advantageous to the central station in terms of the character of the load it produces as it is to the consumer in terms of economy of operation, for it is inherently an off-peak load: not off-peak in terms of day and night load, but off-peak with respect to the cooking peak, which, in the light of the rapid increase in the cooking load, is the new peak which the domestic feeder load curves are now developing.

Hot water is used in greatest quantities just after meal-time, and the multiple control is so designed that it lags from 20 to 40 minutes after the water is drawn, which throws the water-heating load into the valley just following each meal-time cooking peak.

The diversity factor which will be obtained on great numbers of these heaters, each intermittently operating and having individual diversities of six, would seem to indicate that this heater opens up a new field of central station endeavor even larger and more profitable than electric cooking.

The electric heating and cooking department in San Francisco is in charge of R. A. Sharon who, with a corps of assistants, now devotes his time exclusively to this branch of the company's business.

PARALLEL OPERATION OF ALTERNATORS.

BY L. J. CORBETT.

(This paper discusses the effect of differences in speed, field excitation, wave form, and voltage and speed variations with load variations of alternators connected in parallel, special attention being given to difficulties in the parallel operation of water-wheel and gas or steam engine driven units. The author is professor of electrical engineering at the University of Idaho, at Moscow, Idaho.—The Editor.)

The first recorded instance of parallel operation was in 1869 when Wilde demonstrated that two machines producing an alternating current could be run upon the same load. This was lost sight of for sixteen years while investigators were ignoring the possibilities of alternating current and developing the direct current system. In 1884 Hopkinson showed by mathematical analysis that the parallel operation of alternators was practicable, and later demonstrated the fact by experiment. But even then the significance was not appreciated by the commercial world for the day of the transformer was not yet. So we find that commercial use of this discovery was not made until well along in the 80's when alternating current commenced to be a serious competitor of the direct current system, and more especially after 1892 when polyphase transmission was fully demonstrated.

When these principles were first utilized, it was on a small scale within the small plants of the day. As was already practiced with direct current machinery, it was found possible with the alternating current units to add unit after unit as the load upon the plant required and thus keep operation at a fair degree of efficiency. The same principles have been expanded since the days of polyphase current and we now have not only alternating current machines running in parallel in the same station, but stations operating in parallel, feeding the same distribution district in a large city, and stations operating in parallel feeding into an extended system of miles upon miles of high tension transmission and tie lines furnishing power perhaps to several municipalities.

Some features of parallel operation are within the control of the manufacturer alone, and some are within the control of the operator. Still others are to be controlled by the electrical engineer, who designs the plant, and even by the construction foreman.

Properly speaking, any alternator may be run in parallel with any other alternator. Any single phase machine may be run in parallel with any other single phase alternator, or with one phase of any polyphase alternator. One phase of any polyphase machine may be run in parallel with one phase of any other polyphase alternator. Usually, in present practice, we have all phases of a polyphase alternator running in parallel with all phases of another alternator or of an operating polyphase system of the same number of phases. For first consideration we may limit our study to the operation of a single phase of one alternator with a single phase of another, with no more than a limited amount of station wiring, switches, etc., connecting the machines.

From this standpoint the ideal conditions for parallel operation are:

(a) The speeds of the machines must be such that the frequencies are the same.

(b) The field excitation of both machines must be such as to give the same effective voltage at the point of connection.

(c) The form of the waves of e.m.f. of the two machines must be identical.

(d) The "compounding curves" of the two machines—the variation of voltage with percentage variation of load, must be the same.

(e) The curves of regulation of the prime movers driving the machines—the variation of speed with percentage variation of load, must be identical.

If these several conditions obtain, after the machines are synchronized and the first adjustments made, there will be little for the station operator to do. If these ideal conditions are maintained, we can readily see that there would be no cross-currents causing losses in the connections.

What we know as satisfactory parallel operation falls far short of this in every one of the requirements. We depend upon the cross currents to hold our machines together, and allow ourselves wide latitude in many of these particulars. It is the purpose of this article to consider in a general way variations from the ideal conditions and their effects.

Alternator Speed.

Taking up the first division we find the speeds of the alternators the field in which the most trouble was experienced in the early days of parallel operation, and in which it is still to be found in certain classes of plants. Water wheel and steam turbine units are particularly free from trouble in this respect as they have imparted to them a uniform rotary motion, and it is possible to regulate their speed to an extreme nicety, so that cycle after cycle of voltage

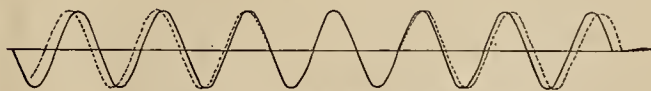


Fig. 1. Effect of Paralleling an Engine Driven Unit with a Uniformly Rotating Unit.

from two units will rise and fall in perfect step. But once introduce a steam or gas engine into the system—any reciprocating engine unit—and this condition is affected to a greater or less extent, because of the variation of speed at various parts of the stroke. The average time of a revolution of the alternator may be such as would give the proper average frequency, but the actual speed will swing from faster to slower than the average. If then an engine-driven unit is paralleled with a uniformly rotating unit, it will forge ahead for a few waves, be in synchronism for a wave or two, then drop back behind the other for a few waves, and then speed up again as before. While it is ahead of the other machine it will furnish current not only to the common load but also to the first machine to the extent allowed by the differences in voltage from instant to instant and the impedance of the completed circuit between the machines. While it is behind the other, the smooth running machine will send current through the circuit connecting the two. These cross currents are not wattless, but transfer energy back and forth between the machines in order to keep them in step, or within the limits of variation allowable before they will fall out of step. Should they

fall out of step, the protective devices will cut one or the other machine out as soon as the difference between the instantaneous voltage is sufficient to force through the circuit the current for which they may have been set.

Alternators coupled to steam or gas engines are subjected to impulses at certain points during each revolution. Such a unit when paralleled with a turbine or water wheel unit gives rise to cross currents of the nature just described. When two units of this character are run in parallel with each other, the conditions are liable to be aggravated. Even if the two units are of the same characteristics the machines may be thrown together in such a way that the impulses come at different parts of their respective revolutions. When one is going fast on admission, the other may be going slow on compression. The cross currents between the machines will be eliminated if they are so connected that the impulses coincide, but the frequency of the whole system then rises and falls, and this condition causes pulsation between the set of generators and any synchronous motors or converters on the circuit, reducing their maximum output. This is notice-

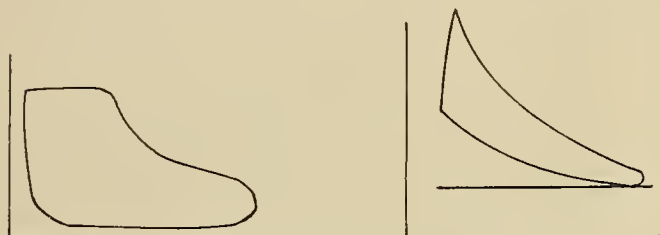


Fig. 2. Steam Engine Card. Fig. 3. Gas Engine Card.

able even in cases of small variations in angular velocity of engine speed.

Difficulty is encountered when units of the same kind, but of different speeds and different numbers of poles for the same frequency, are run in parallel; for impulses are constantly forcing one machine or the other ahead, and causing cross currents between them. At certain periods these impulses may coincide and at others they may be opposed and make it difficult for the machines to keep in step. In many plants containing such units, the condition of parallel operation is unstable; possibly the machines will run smoothly together under steady load or under steadily changing load, but if sudden fluctuations occur, the breakers are opened on some occasions but not on others, although the fluctuation may have been of the same amount and character.

Under the same category might come the use of units driven by different types of steam engines, such as a single cylinder or tandem compound engine unit paralleled with a cross-compound or triple expansion unit. A peculiar instance is reported by F. D. Nims as having occurred in Mexico City. In one station there was a 3-phase 60 cycle alternator driven by a triple expansion upright engine without a flywheel. Connected to the main shaft by a crank was a heavy displacement pump for circulating the condensing water. To compensate for the weight of the piston of the displacement pump, the cranks were spaced, not all 120 degrees apart, but about 115, 120 and 125 degrees. This unit operated in a satisfactory manner alone, but in an unstable and unsatisfactory manner

when paralleled with the rest of the system. A heavy and regular pulsation was set up throughout the circuit. This of course is an extreme case, but it illustrates conditions to be guarded against, and it shows what occurs to a lesser extent when units whose impulses differ in time are operated in parallel. The gas engine must come in for its share of consideration, as the nature of its cycle differs from that of the steam engine. Inspection of the indicator cards of the two types of prime movers will show what difference may be expected in their angular velocities at different parts of stroke at any stage of load.

It must not be assumed that the writer is blaming all hunting troubles to angular variation alone. If governors were perfect, the average speed of a revolution constant in every case, we would still have cross currents between machines due to the conditions just described, but they would not be responsible for hunting. This is a complex phenomenon depending upon a number of factors. In engine driven units it is often said to be the fault of the governors but it is also to be found when synchronous motors or rotary converters are connected on the line. The angular variation does, however, introduce into the system an unstable condition every few cycles, independent of load changes, and if units are so related as to fly wheel weight and governor action that they are liable to hunt, that condition will be ever present.

Field Excitation.

A matter which has come in for a great deal of study and discussion is the effect of variation of field excitation. The change from direct current to alternating current had a certain amount of inertia to overcome in the methods of the station operating force. It was a simple matter to weaken the field of one direct current generator, feeding into a system until the ammeter reading fell to zero and then open the switch without producing an arc. But the same method applied to an alternator had no such result. The ammeter showed no diminution of current, possibly even an increase as the field was reduced, and if the reduction was persisted in, increasing pulsations would occur until finally the breakers, or the expulsion fuses used in those days, would open the circuit.

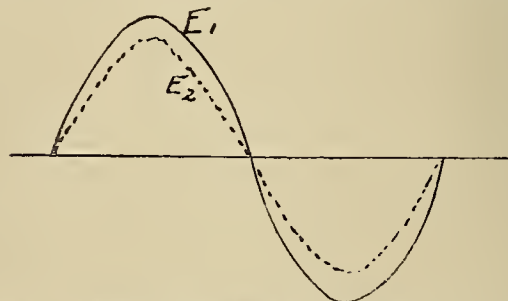


Fig. 4. Effect of Difference in Field Excitation of Rigidly Connected Units.

If the two alternators are excited so that the waves of e.m.f. coincide in value at all points there is no exchange current between them. If, however, one machine has a higher excitation than the other we do not have such a condition as represented in Fig. 4, unless they are rigidly connected together. What we do find is the condition shown in Fig. 5, an actual

displacement in phase of the e.m.f.'s supplied by the machines of the external circuit. To complete the triangle, there must exist an e.m.f. between the two machines, which causes a current to flow between them, its value depending upon the impedance of the machines and the connecting circuit. Or referring to the curves of voltage as platted, the curve E_3 of e.m.f. between machines or tending to send current through the series circuit, is such a curve that if added to E_2 , the e.m.f. of the under excited machine, the result will be E_1 .

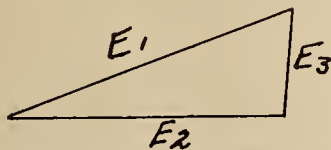


Fig. 5. Phase Displacement Caused by Difference in Field Excitation.

A paper by Welsh, before the A. I. E. E. at Portland in 1912, presents a treatment wherein load is said to be shifted in two ways, by adjustment of the governor of the prime mover, and by field adjustment. As was brought out, however, in the paper and particularly in the discussion, field adjustment served the

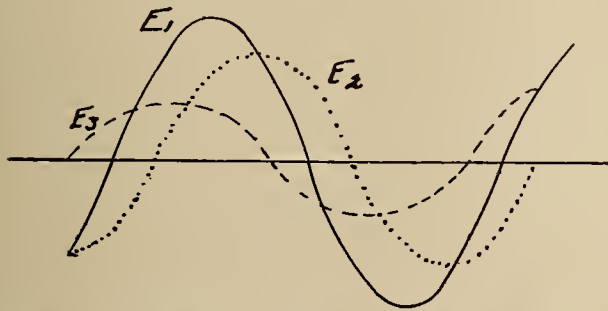


Fig. 6. Usual Effect of Difference in Field Excitation..

purpose only when accompanied by a change in governor setting; and when stations were connected through lines chiefly of resistance, raising the bus bar voltage of one plant and lowering it in another caused a transfer of load.

Within the limits of one station, however, with the ordinary low resistance station wiring between machines, no appreciable change in actual load can be made by varying the field excitation. The power factor of the load the machine is carrying will be altered, but with any given setting of the governor the power will be the same. Increasing the field excitation will cause the generator current to lag, while lowering the excitation will cause the current to lead the bus-bar voltage.

Any difference in the excitation causing the effective values of e.m.f. to differ, causes cross-currents between the machines with the attendant magnetizing and demagnetizing effects of the leading and lagging armature currents.

Wave Form.

When two alternators differ in wave form, they may have the same effective value of e.m.f. and run in parallel, but there will be high frequency exchange currents between the machines. If two curves such

as are shown in Fig. 7 represent the waves of e.m.f. of two alternators E_1 and E_2 , the curve E_3 will indicate the difference between them from instant to instant, and due to this difference, an exchange current will flow between the machines. This current will be more or less distorted depending upon the har-

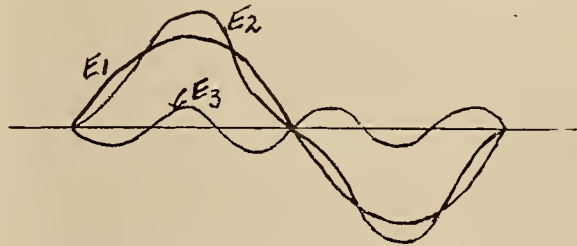


Fig. 7. Effect of Difference in Wave Form.

monics present and upon the characteristics of the series circuit. It will be superposed upon the regular synchronizing current upon which we may be depending to keep the machines in step, and at times of load change will tend to additional instability. Another effect of the higher harmonic cross-currents is to set up rotary fields which are superposed upon the alternator fields. The rotation of the field of the third harmonic is in the opposite direction to that of the alternator field, and if this component is large it may seriously affect the parallel working. The amplitudes of the fifth and seventh harmonics are usually so small that their effects are not serious, but they add to the resistance, hysteresis and eddy current losses.

Compounding Curves of the Generator.

In the ordinary course of operation of a power plant, typified by a plant supplying a lighting load, the load changes are gradual. If we have machines of different characteristics so that the voltage of one drops to a greater extent with a given percentage addition of load than the other, we will not have a proper division of load between the two, and though they may be adjusted for proper division of load of a certain value, for any other value, one will be over-excited and the other will be under-excited, leading to conditions discussed under that heading. Closely allied to this is the matter of the curves of regulation of the prime movers driving the generators, for upon the governors depends primarily the division of load. If the governors do allow equal division of load at all percentages of load, but if the excitation does not vary in the proper proportion in both machines, they may carry their proper share of load but with excessive cross currents which introduce losses, excessive armature reaction, heating and instability.

The actual division of load as has been stated, depends upon the governors and their regulation of the prime movers. If we had what is called an "Ideal" governor we would have a perfectly flat speed curve. With such perfectly flat speed curves on both of two prime movers, we would have no tendency for load division whatever between them, and upon a change of load occurring on the mains, the load division would be due to very complex inter-related causes. It would be influenced by field adjustment to a greater extent in this case than in any other, but also by the characteristics of the con-

necting circuit and by the power factor of the load. The load division would be decidedly erratic and eminently unsatisfactory. It would depend upon Professor Franklin's "Physics of Chance," whether the load would swoop to one machine or the other, for the governor's work would be accomplished when normal speed was restored, whether there was no load on the alternator connected to its prime mover or an overload. Fortunately for parallel operation, governors can be set to allow a variation of speed from no load to full load. If the governors on both units, or on all the units in a power house, are set to allow the same variation in speed for the same variation of load, and if they are of the same type of governor, thus having similar curves of regulation, then the governors will automatically cause the sharing of the load properly among the respective units, for if load tends to come upon one unit the speed will slow down and the faster turning units will then relieve it of load, allowing it to increase in speed and so on until the speed of all units is the same and the load is properly divided among them. A satisfactory amount of drop for prime movers from no load to full load is 2 per cent.

So far as the generating units are concerned, these points should be kept constantly in mind, and proper precautions taken to eliminate, as far as possible, unfavorable conditions. We have come to depend upon the synchronizing current between machines to hold them in step, and it should be our aim to so design and operate a station that this current is kept at a reasonably low value. In a well-designed and well-operated station the synchronizing current is ordinarily at a low, practically negligible, value, except when changes of load occur, at which time they may increase momentarily until the proper adjustment of load is obtained, when they again subside. The selection of prime movers should be made with reference to the uniformity of rotation as well as other economic conditions, and in general, types differing too greatly in angular variation should not be chosen, or if chosen proper fly wheel weights should be used to keep the angular variation within suitable limits. Here again we have to be careful in our selection of fly wheel weights. If very heavy fly wheels are chosen there will be rather long natural periods of vibration, and any surging which may tend to develop will be eliminated by the governor. On the other hand, if very light wheels are used, the synchronizing currents are able to act much more quickly than the governor, so the task of maintaining the speed devolves upon them. Intermediate between these extremes, surging is apt to occur and to be assisted by the governor unless proper adjustment of its dash pot is made. Without such adjustment the task of synchronizing currents, of keeping the machine in step, becomes more and more difficult as the weight is increased within the limits of this intermediate zone. Common practice is to allow an angular variation of ± 2.5 electrical degrees. For this variation greater fly wheel weight will be necessary in a gas engine or a single cylinder steam engine than in a triple expansion engine.

In choosing generators it is common practice to have all the units of a power house made according to the same specifications. It frequently happens, how-

ever, that units are added to a plant in later years, and in that case it is well to guard against selecting units of a different wave form. It may be inadvisable to get machines of the same pattern as were first installed, but they should at least conform in general features, so that the wave form of the first machine will be approximated, if we would avoid needless waste of energy in cross-currents. For instance, we may expect cross-currents if the new machines have two slots per pole per phase and the old ones three.

If an entire station be added to a system and connected by a transmission line of appreciable resistance and impedance, the cross-currents will usually be insignificant.

In the field adjustment lies perhaps the greatest possibility of eliminating needless cross-currents within the control of the operator. If the compounding curves of the alternators are alike they will maintain their proportion of load (provided the governors are properly set) though the voltage will drop unless some provision is made to keep it up. The voltage of the bus-bars can be raised by increasing the fields of all the units. Cross-currents can be guarded against by using power factor meters on each machine and adjusting the fields so that each of these agree with that on the mains, or by occasionally testing the field adjustment for minimum armature currents as indicated by ammeters on each board. These adjustments are interdependent among the machines, and may have to be repeated a time or two before the final result is obtained.

CHANGES AT GATUN HYDROELECTRIC STATION.

Extensive changes have been authorized for increasing the capacity of the hydroelectric plant at Gatun, Panama Canal. New turbine wheels have been ordered for the three turbo-generator sets, each of 4400 h.p., instead of 3100 h.p. as at present. No change will be made in the generators, as the very liberal design of these units makes it possible to operate them with an output of 3650 k.v.a., at 80 per cent power factor and 55 degrees centigrade temperature rise.

In order to take care of the increased output of these generators, four new 400,000 circular mil cables have been ordered for installation between the hydroelectric station and the Gatun substation. The present cables between these two points are ten in number and are of No. 0000 size, which corresponds to an area of 212,000 circular mils. The necessary switches, instruments, etc., for these cables have been ordered both for the hydroelectric and the Gatun substation.

In addition, two 4000 k.v.a. power transformers have been ordered for the Gatun substation. These are the largest transformers that can be installed in the existing compartments. There is now one vacant compartment for one of these transformers, and the other compartment will be procured by moving one of the present 2667 k.v.a. to the Cristobal substation, where it will be needed to take care of the increased load at that point, due to the operation of the new coaling plant, and the new terminal piers, and to the projected submarine base at Cristobal.

CRITICISM OF FERRIS BILL.

BY C. C. CHAPMAN.

(This letter was written by the author to an Eastern banker who made inquiry concerning the Ferris water power bill. It formed the basis of a talk before the Luncheon Club of the Section of A. I. E. E. and N. E. L. A., Portland, Oregon, March 30, 1916. Mr. Chapman is editor of the Oregon Voter.—The Editor.)

Referring to your inquiry concerning the objectionable features of H. R. 408 (the Ferris Water Power Bill), will state that as reported back to the Senate by the Senate Lands Public Committee, many of said objectionable features have been eliminated.

There is danger, however, that same will be amended back into the bill either from the floor of the Senate or in conference.

The House leaders and many of the Senators are strongly in favor of radical, repressive legislation, and when the bill goes to conference there is a strong probability that extreme views will prevail and that many of the objectionable features will be restored. I gravely apprehend the bill will be passed in form that virtually prohibits extensive water power projects where the use of any portion of public lands for power sites or rights of way is involved. The only hope for fair legislation is to continue to impress the senators and representatives with the necessity of enacting conditions that afford reasonable security to an investor and a prospect of ultimate reasonable profit.

The House bill "authorized and empowered" the Secretary of the Interior to lease public lands for water power development. The Senate amendment "authorizes and directs." The theory of the Senate amendment is that after an applicant for a lease has gone to great expense locating a site, finding a market for power, preparing plans, and arranging his finances, and in his application conforms with all of the conditions laid down by law, the Secretary should be required to consider his application in the order in which it is received for the particular right; and if the applicant is entitled to the lease it should be mandatory upon the Secretary to allow said application. Lodging discretion with the Secretary by "empowering," not "directing" him to lease would enable him to play favorites. It is doubtful whether capital will undertake the heavy expense of engineering and financing when it is feared that the Secretary may reject the application in favor of some other applicant who is more highly regarded by the Secretary. Water power developers are entitled to know in advance what the conditions are with which they must conform, and to know that when they have conformed with said conditions the government will grant the lease sought.

The House bill empowers the Secretary to make leases "for a period of not longer than fifty years." The Senate amendment directs that leases be made "for a period of fifty years unless the applicant and the Secretary agree on a shorter period as the applicant for lease may elect." Under the terms of the House bill the Secretary may arbitrarily reject an application for a fifty year period or insist that it be reduced to a fewer number of years. Under the Senate bill the applicant would have the right to apply for a fifty year lease, or for a lease for a less period as the applicant might elect. Again, this gives the applicant

the definite right instead of placing him entirely at the mercy of the Secretary.

Under the House bill the Secretary is empowered to make a lease "under general regulations to be fixed by him and under such terms and conditions as he may prescribe." In the Senate amendment the Secretary is directed to lease simply "under general regulations to be fixed by him," and he is not empowered to prescribe terms and conditions other than those imposed by the Act itself and published regulations. It is readily apparent to any business man who has had dealings with the government that in applying for a lease he should be permitted to know in advance the terms and the law and regulations so he can plan accordingly, and should not be placed at the mercy of department or bureau officials who later might prescribe terms and conditions of a character of which, had he known same in advance, would have convinced him of the uselessness of undertaking the proposed costly development.

The House bill gives an advantage to states, counties or municipalities for municipally-owned electric plants, and specified that the Secretary may in his discretion "give preference to such application."

The Senate amendment plays no favorites. It neither denies to municipalities the right to apply for leases, nor does it discourage the private investor from undertaking expensive development by notifying him in advance that after he has gone to heavy expense the law permits the Secretary to reject his application in favor of an application made by a state, county or municipality, possibly for the sole purpose of defeating the original application made by private capital. Both bills also provide that no rental charge shall be made for lease to municipally-owned plants, thus again putting a premium upon hydro-electric development to be undertaken at the expense of taxpayers in contrast with development to be undertaken by private capital, saving the taxpayers of municipalities all the cost and risk of going into a business which might be engaged in by private capital if conditions were equal.

The House bill requires of the Secretary of Agriculture to certify that the development of power will not be inconsistent with the purpose for which a forest reserve was created. This requirement has been eliminated in the Senate committee amendment, thus avoiding the danger that after an applicant shall have gone to such heavy expense in good faith and bound himself to conform with the law and the regulations, he shall not further have to negotiate with an entirely different department of the government and be at the mercy of the officers of an entirely different department which can impose new conditions which, if understood in advance, would have deterred the applicant from undertaking his project at all.

The House bill provides "that the lessee shall at no time contract for the delivery to one consumer of electrical energy in excess of fifty per centum of the total output, except upon the written consent of the Secretary of the Interior." This lodges power with the Secretary to reject a lease for a project which might be built for the sole purpose of supplying electric power to a railroad, to a large manufacturing establishment (for instance for the manufacture of fixed nitrogen), or for any other one industrial use. If a lessee should

propose to develop 50 h.p. to be sold to one railroad he might be required to develop another 50 to be sold to communities which already were over-supplied with electric energy for general use, or he might be limited to the sale of only 25 of his 50 h.p. development to the railroad which could use the whole fifty and would be forced to find a market for the other twenty-five under conditions which would make it practically impossible for him to find such market in the particular locality in which his power is available. Capital will hesitate to undertake such needed development to supply power to railroads, or single large industrial users, when facing the contingency of having to develop twice as much power as is needed for the particular use and having to find a market for the excess.

The House bill lodges with the Secretary of the Interior the power to regulate Interstate Commerce in electric energy from such plants as are operated under the government leases. The Senate committee reposes this power in the Interstate Commerce Commission.

The House bill lodges with the Secretary of the Interior the power to regulate the issuance of stocks and bonds by the lessee. The Senate amendments eliminated this.

It should be remembered that this proposed regulation, both as to service and issuance of securities, is restricted solely to lessees of government land under the proposed Act; it does not apply to interstate use of power on lands no portion of which are leased from the government, or to issuance of securities by corporations which are in no wise dependent upon government leases. Thus the Act is discriminatory in providing federal regulation for one class of power companies while exempting all other classes of power companies from regulation, either as to price, service or issuance of securities. This is a rank discrimination against the Western public land states.

The House bill requires the written consent of the Secretary of the Interior for any sale or delivery of power (excepting thirty-day emergency sale) by the lessee to any distributing company, and also requires the written consent of the Secretary for the assignment or transfer of the property depending on the lease, or for physical combination of plants. The Senate amendment permits the lessee to sell power wherever he can, subject to law and the local public service regulations, and also permits the sale or assignment of the lease itself. It will readily be seen that any secretary controlling the business transactions of a lessee would be in a position to dictate ruinous terms whenever application is made for his consent to a purely business transaction.

Both bills provide that the United States shall have the right to take over all the properties that are dependent in whole or in part for their usefulness on the continuance of the lease. This provision confronts the investor with the contingency that all the properties in which he has invested,—perhaps great distributing systems covering chains of communities for which most of the power obtained is from privately owned lands—may be taken over by the government at the expiration of the lease on one power site, or

even on the right of way over a distributing line which may supply only a small portion of the energy which goes into the general distribution of all the properties with which he is connected. The government by virtue of leasing only one small power site, or a right of way for a poleline has the edge on controlling an entire distributing system which is dependent only in part on power sites or right of way leased from the government. This would be in spite of the fact that the very water used on the government land actually belongs to the state. Power developments are very costly and hazardous; and to limit the hope of return to a fifty year period at the end of which all the properties, even indirectly connected, could be taken over by the government, is to deter and discourage investment.

The House bill provides that the government, in taking over the property, shall pay, first, only the actual costs of rights of way, water rights, lands and interests that are owned by all the properties connected with a government-owned site or right of way, and, second, the reasonable value of all other property limited by the drastic provision "that such reasonable value shall not include or be affected by the value of the franchise or good-will or profits to be earned on pending contracts, or any other intangible element." This severe provision forces the investor to realize that all the value of good-will of an established business, built up by years of pioneering and development expenditures covering all of his properties, shall entirely cease at the termination of a lease covering only a small part of his system. The Senate amendment substitutes for this drastic provision the very reasonable and satisfactory requirement "that such fair value shall not include or be affected by the value of any public lands, rights of way, franchises, or other property leased or granted under this Act by the United States"; but adds to that proviso the onerous condition "or by the good-will or prospective revenues." No one objects to excluding all the value of the property of the United States from any reimbursement to be made to private capital. There is no longer any serious attempt to appropriate to private profit United States property in power sites or rights of way for transmission lines; but investors do object to losing all the good-will of an established business at the end of the lease period on a lease which covers only a small part of the power generated and sold in a large business.

The Senate bill provides that in the event the United States does not exercise its right to take over the properties and makes no lease of all of said properties to a new lessee, the old lessee shall be permitted to continue in ownership and control of his properties. There is no such permission in the House bill.

The Senate amendment also gives the original lessee a preference right on renewal, while the House bill gives the original lessee no such preference right.

The House bill specified that when "in the judgment of the Secretary of the Interior" the public necessity requires or justifies the lessee in contracting for the sale of power beyond the life of the lease that such contracts may be made for a period of twenty years beyond the termination of the lease. The Senate bill lengthens this period to twenty-five years, and lodges no such discretion in the judgment of the Sec-

retary of the Interior, merely requiring that such contracts may be entered into upon the approval of the Public Service Commission of the state and of the Secretary of the Interior, subject only to laws and public regulations, instead of permitting the Secretary to determine the matter arbitrarily.

Both bills permit the Secretary to fix the charges for land leased on the basis of the power developed and sold. This arbitrary rate-fixing power should not be lodged with an administrative officer. He can specify one charge to one lessee and another charge to another lessee. The charge should be fixed by law and should be alike to all who develop and use the same number of horsepower. Then the developer will know in advance what charge he must face; and if he does not see his way clear to make a profit on the basis of the other charge fixed by law, he can drop the subject. If he is confronted by the contingency that an arbitrary official can fix a charge based on that official's estimate of the possible profit to be made from the project, and based on a political policy of squeezing nearly all the profit out of a particular project, it is doubtful whether many investors will care to face such a possibility.

Both bills require that leases made to municipal plants shall be without charge for power. This is a discrimination against private capital, and puts a premium on municipalities undertaking risky and costly power development at taxpayers' expense; when, if conditions were equal, private capital might be induced to make the development without burdening the taxpayers.

The House bill prescribes that the Secretary of the Interior shall regulate rates and service in any state which has no public utility commission. This provision is aimed squarely at the state of Utah, which alone of all far Western states has declined to establish a public utility commission on the theory that every encouragement should be held out by Utah to capital to develop its natural resources without fear of having the profit regulated out of the business. This is a local policy and should not be penalized by the Government.

Both bills require that the lessee may be required by the Secretary of the Interior to submit statements and reports covering every detail of every ramification of business in all the properties connected with the power plant or transmission line which happens to be located on government land, irrespective of whether any considerable proportion of the power actually used comes from or over government land. This simply makes one more series of reports which must be filed by a corporation, and another authority with whose rules and regulations the corporation must conform in its accounting. Already the burden of accounting and reporting to different public authorities is almost ruinously heavy; and it seems an economic crime to require that still further detailed reports shall be made to still other official authorities under new conditions to be prescribed by them.

A rank piece of hypocrisy is in both bills—"that nothing in this Act shall be construed as affecting or intending to affect or in any way interfere with the

laws of any state relating to the control, appropriation, use or distribution of water." By virtue of owning the power site and right of way the government assumes and enforces control over every feature of the use of the state's water. And this section is inserted merely as a sop to the people who believe that the state should have something to say about the use of the water which it owns. The section is meaningless and viciously deceptive.

The House bill requires that each lease shall be conditioned upon the acceptance by the lessee of all the terms specified in the lease, which sounds all right until it is remembered that the Secretary of the Interior (and in some cases the Secretary of Agriculture) has authority to insert arbitrary conditions in said lease, which conditions, if known in advance, would have prevented the investor from going to the enormous expense of engineering and financing the project.

To summarize, the bill as it passed the House is so drastic and restrictive in its actual terms, and imposes such a degree of arbitrary authority upon the Secretary of the Interior (and in some cases on the Secretary of Agriculture) that the prospective developer will hesitate to take a chance on reaping an ultimate profit from his investment unless he stands so well with department and bureau officials that, by virtue of his acquaintance and the personal regard in which his political opinions are held, he is enabled to secure favorable terms, regulations and special conditions from the secretaries.

To summarize; as amended by the Senate committee, several of the most drastic provisions are removed and other conditions are made definite instead of being left to the arbitrary whim of an administration officer. However, the Senate amendments do not go far enough. The charge to be made for water should be fixed by law and some other burdens should be removed.

It should be clearly kept in mind at all times that no attempt is being made to appropriate to private profit any of the value of the government lands or of leases obtained from the government; that no attempt is made to obtain provisions that would permit capitalizing these intangible values; and that no one seeks to have the government give its power sites in perpetuity to private individuals who can reap a large profit from the value of said lands. Advocates of the Ferris bill raise the hue and cry that opposition to it is dictated by people who desire to appropriate government lands and capitalize their value, thus reaping enormous profits from the value of the sites and rights of way. These allegations are absolutely false and should not be permitted to mislead public sentiment.

Both bills prohibit liens on any related properties without consent of the Secretary. When all a company's properties are covered by a mortgage upon which bonds are issued from time to time, further issuance of said bonds would be impossible after the company become a lessee of any government lands unless the Secretary approved all the terms of the original mortgage; and the mortgage could not be modified to meet his exactions without the consent of holders of earlier bonds.

THE MEDLOW DAM.

BY PERCY ALLAN.

(This interesting account of the features of a thin profile dam, as compared with the Bear Valley dam in California, is taken from the Commonwealth Engineer of Melbourne, Australia.—The Editor.)

The Medlow dam, on account of its slender profile, is one of the most remarkable in the world. It stands as a sheet of concrete in a sandstone gorge on Adams Creek, in the Blue Mountains of New South Wales. The wall, with a vertical upstream face, is built on a curve of 60 ft. radius, and is 65 ft. high from the foundation to the top of the parapet. The wall has a base width of only 8.96 ft., tapering on

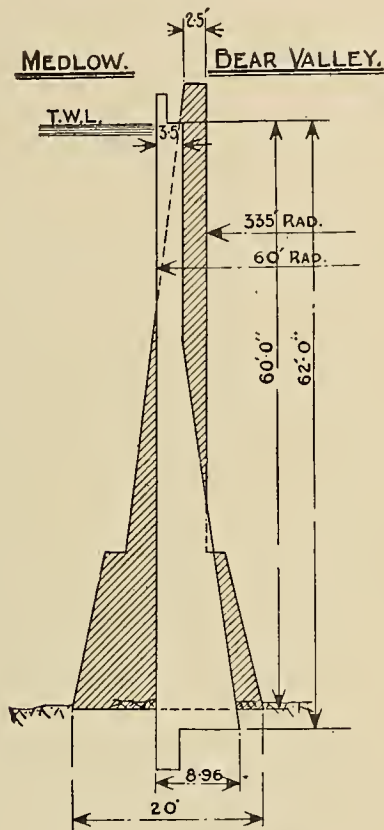


Fig. 1. Comparison of Profile.

the downstream face to 3 ft. 6 in. at a height of 29 ft., thence 3 ft. 6 in. to top water level, finishing with a parapet wall 1 ft. thick for the remaining 3 ft. of height.

Although the old Bear Valley dam, built in California in 1884, and superseded in 1911 by a multiple arch dam, has in the past been referred to as having the thinnest profile in the world, yet a dam built on Crowley Creek, in America, in the same year as Medlow Dam has a thinner profile, whilst Fig. 1 shows the profile of the Medlow dam to also be thinner. The Medlow wall, however, is—due to the narrow gorge—built on a very much smaller radius, viz., 60 ft. as against 335 ft., the maximum pressure on the concrete being only 12 tons per sq. ft., as against 53 tons per square ft. on the granite voussoirs in the old Bear Valley dam.

In determining the profile of the Medlow dam, the wall was treated as a section of a rigid cylinder, subject to external water pressure, any assistance due to the weight of the wall being disregarded.

The formula used was: $T = \frac{RP}{S}$

where T denoted the thickness of wall at any level in feet,

where R denoted the radius in feet,

where P denoted the water pressure in tons per sq. ft., and

where S denoted the stress in tons per sq. ft.

The limiting pressure adopted for the concrete was 12 tons per sq. ft., whilst the highest water surface was taken as within 1 ft. of the top of the parapet wall, or 2 ft. above the overflow of spillway.

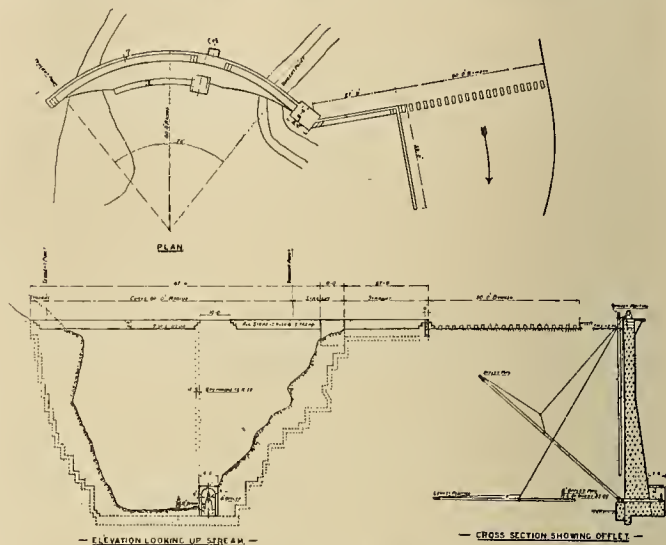


Fig. 2. Mellow Dam Sections.

$$P = \frac{62.5 \times 62}{2240} = 1.73 \text{ tons.}$$

$$T = \frac{60 \text{ ft.} \times 1.73 \text{ tons}}{12} = 8.65 \text{ feet.}$$

The dam is built of concrete without any reinforcement or "plums." The concrete was composed of 13 cu. ft. of ironstone 2 in. gauge and 8 2/3 cu. ft. of 3/4 in. screenings, to 13 cu. ft. of sand, to 375 lb. of cement.

With a view to determining the crushing strength of the concrete as under actual conditions in the work, samples were taken from time to time off the banker board, just as the concrete was being placed in the work, and were then made into 6 in. cube blocks. The seven blocks tested showed at two months a crushing strength of 93 tons per sq. ft., and at three months from 93 tons up to 116 tons per sq. ft.—the limit of the machine. One block, however, at 35 days also beat the machine at 116 tons per sq. ft.

Good close sandstone was met with in the foundation trenches, but on either side considerably more excavation had to be taken out than was anticipated in the office plans, as fissures and large bands of iron stone running in all directions had to be contended with.

Along the front line of trench, at intervals of 6 ft., holes, reaching to the bottom of the foundation, were left in the concrete, whilst chases were cut in the different benches in each cliff. After the concrete had thoroughly set, iron pipes were temporarily cemented

in the holes and chases; cement grout under pressure was then forced down the pipes with a view to filling any spaces between the rock face and concrete.

The whole of the concrete was mixed by hand, on a platform located at the top of the southern cliff, and delivered thence into a hopper provided with a long timber chute reaching to the bottom of the foundation, or such position on the wall as required.

Fig. 2 shows various sections, etc., of the dam. Fig. 3 shows the finished dam.

To provide a supply of water for concrete, two small tanks with earthen bag wall dams were excavated at a level to command the mixing platform, the water being raised from the creek bed by means of a No. 7 Danks' hydraulic ram. To obtain the necessary head of 12 ft. for working the ram a timber dam

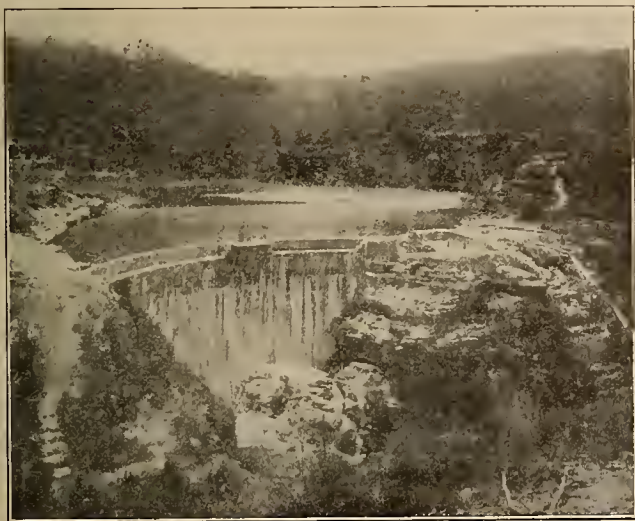


Fig. 3. The Finished Dam.

faced with a clay bank was built some little distance upstream of the site; thence along the bed of the creek was laid the drive pipe of artesian bore casing, some 489 ft. long by 4 in. outside diameter. The delivery pipe was $1\frac{1}{2}$ in. inside diameter and 335 ft. long. The ram discharged into the upper tank against a head of 130 ft., exclusive of friction. Under these conditions, the ram discharged 54 gallons per hour. Both tanks were filled before starting the concreting, and with a continuous supply of 54 gallons per hour, no shortage of water was experienced in working the 48 hours a week. A batch of concrete was usually found to require 35 gallons of water.

The vertical timbers supporting the profile boarding were of 6 in. by 4 in. hardwood, blocked off the concrete and connected thereto each with two $\frac{7}{8}$ in. bolts, with nuts at each end, built 10 in. into the concrete. The bolts were oiled and no difficulty was experienced in unscrewing them from the nuts which were left in the concrete, the hole being then washed out and plugged with cement mortar.

The lagging was of dressed tongue and groove Oregon pine, 1 in. thick, nailed to 6 in. by $2\frac{1}{2}$ in. dressed pine horizontal ribs cut to radius, the segments being 4 ft. 6 in. deep and in 6 ft. 6 in. lengths. The face of the lagging was coated with soft soap immediately before the concrete was placed in position, the concrete

being allowed to set for 48 hours before the profile boarding was removed; the concrete face was then given a coat of cement wash.

A natural depression on one side of the gorge was fashioned into a spillway, discharging some little distance downstream of the dam, whilst the parapet wall of the dam itself, 3 ft. above the over-flow level of spillway, ensures the whole of the flood waters being passed into the creek without over-topping the dam—a matter of first consideration, with a thin wall without water cushion at base.

The catchment area is 1150 acres, with an average rainfall of 39 in., the dam holding up a lake 0.62 miles long with a water surface of 12 acres, containing 67 million gallons of very good water. The trees, stumps, scrub, and undergrowth were cleared from the site of the reservoir and the whole surface left bare to half a chain beyond the top water level, so that on the reservoir filling no trouble was met with from discoloration or decaying vegetable matter.

The work was completed in December, 1907, and although water was stored to within 19 ft. of top water level in the following February, it was not until July, 1908, that the spillway overflowed. The wall was then reported as weeping at several of the ladder rungs and at two pin holes at the 8 ft. level, whilst a further weep was reported near the top water level which, upon inquiry, was found to have resulted from the upsetting of a bucket of soft soap, which was not washed off before the placing of the next batch of concrete. Whilst an efflorescent or deposit of lime brought out of the cement with the usual sweating is noticeable on the wall, yet the weeps have now taken up, the wall being dry with the exception of some damp patches at one or two places.

The dam was designed in the public works department of New South Wales, under the direction of the late L. A. B. Wade, M. Inst. C. E., then chief engineer for irrigation and drainage, the work being built by day labor under the supervision of Percy Allan, M. Inst. C. E., M. Am. Soc. C. E., then principal assistant engineer for water conservation. The work cost £2762, exclusive of expense involved in clearing the site of the reservoir, costs of preliminary investigation, survey, supervision and engineering expenses.

A tax on receipts of gas and electric companies that had been imposed by a Portland, Ore., ordinance has been declared void by the Oregon Supreme Court. Justice Harris, in his opinion, pointed out that the ordinance could not be upheld, as a tax on property, because the city cannot levy a property tax for general purposes except on the property and as pointed out by the general laws.

The actual performance method of appraisal, as adopted by the Washington Public Utilities Commission in evaluating the Pacific Telephone & Telegraph Company's property in that state for rate making purposes, showed a value of \$19,328,209, as compared with \$26,892,700 total "reproduction cost," including the development cost. This figure will be used as a base in fixing telephone rates in the state.

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Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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The reason for devoting the prominent position in this issue accorded the article on "Developing Electric Range and Heating Business" is because of the importance of this new class of business as a source of central station income, because of the new ideas presented in the paper, and furthermore because it illustrates a recent departure in public utility practice. This display room is not, or at least should not be, a salesroom for electric ranges. Yet it is, and should be, a salesroom for electric service.

An important feature of public utility service is the instruction given to consumers as to how best to utilize available facilities. Electric companies, in particular, have always displayed a broad spirit in this regard. They have gone to considerable expense to explain the use of more economical lamps, even though their revenue would for a time be thus reduced. They send expert advisers to homes and business houses to tell patrons how to improve the results they are obtaining from the use of electricity. And in this instance, one company has gone to the expense of fitting up beautiful display rooms where the prospective electric cooking consumer can conveniently ask questions, receive instruction and compare equipment. Such a feature of electric service makes for better cooking, better digestion and better tempers in the home. It should tend to popularize the electrical ways of doing things and bring about a better and more friendly feeling between the public service company and the public served.

Although discriminatory rates are not legally permissible, an occasional consumer, having secured an unfair rate advantage, fails to appreciate that his "contract" affords no protection under the law. The purpose of a contract is to protect the parties thereto. But, as it is inconceivable that the law should permit that which it prohibits, transactions violating the law cannot be made the basis of contract. A contract contravening a statute is as unenforceable as one secured under duress. Participation in the unlawful intent is illegal and not only voids the contract but forfeits the protection which the courts would otherwise afford.

Laws enacted to prevent rate discrimination prescribe a rule of conduct calculated to prevent selfish persons from sacrificing the public good to personal gain. If contracts ignore this principle, the law protects neither party and even adds drastic penalties. Consequently both a public utility and its consumers are "playing safe" only when the rates for service are in accord with those regularly made. It is questionable whether the courts would compel a utility to execute or pay damages for non-execution of any other kind of rate "contract," nor would the courts be likely to compel consumers to pay delinquent bills or make good any other breach of such a contract.

Uses of a Display Room

Futility of Illegal Utility Contracts

Yet this does not necessarily mean that the consumer would thus escape paying the legal rate. Although the utility could not compel payment, the regulating commission would probably prevent the consumer from enjoying an unfair rate advantage.

Under the subject of contracts, also, it is of value to add that the California Railroad Commission has decided that a public utility may not require a consumer to sign a contract as a condition precedent to service, though it may require a written application for service.

Nearly a century has elapsed since Ralph Waldo Emerson, among others, gave warning that science needed to be humanized. Since that time, the tendency of education has been toward vocational training, material success and increased efficiency. This culminated, perhaps, in a remarkable classification of the principles of scientific efficiency by Harrington Emerson, among others. Herein the individual is urged to establish standards, keep records, plan his work, schedule his time and materials, and aim for dispatch. In this way it is possible to develop a man-machine capable of undreamed of accomplishments.

The more wide-spread becomes the knowledge and the application of these principles, the more rapid will be the progress of material civilization. They are in every way commendable as a means for enabling men to do more things in less time. But they have one flaw—they do not teach whether those things are really worth doing.

Most engineers, scientists, business men and efficiency experts will regard this criticism as rank heresy to the existing order of things. With every thought focused on doing more work more rapidly, with every nerve and sinew strained to increase production and develop natural resources, in brief to earn a living, the question of the "worth-whileness" of all this frantic effort never enters their heads.

The intense activity in breaking down the barriers of nature is a reaction against a former period when men did not give enough attention to the problem of making a living and when too much interest was taken in the humanities. As engineering represents the utilization of the powers of nature, the engineer has been the pioneer in the revolt against the humanities, the classics, which, while well adapted to training the true man, are not fitted to perfecting an efficient man-machine.

The natural consequence of intense specialization, which is essential to success in science, is narrowness, one-sidedness and intolerance. So the engineer, as an applied scientist, needs some broadening influence, something that will develop the remaining sides of his triune nature, some means of acquiring a deeper human sympathy.

This something is the crystallized thoughts of

men, the classics, which have continued to live for centuries after men's engineering structures have failed to withstand the onslaughts of nature. And the engineer, as the pioneer in showing people how to solve the material problems, can well afford to aid in the solution of the complexities of human relationships which now threaten to destroy much of our machine-made civilization, labor troubles, class hatred, and international warfare.

The engineer's first reply to this suggestion, delivered with all the effect of an ultimatum, is "I haven't the time." Think of such an excuse from the men who have increased the effective time of life many-fold, by annihilating distance with modern means of communication, by eliminating the sources of disease with proper sanitation, and by turning night into day with electricity. Neither does the business man, the commercializing scientist, whose time has been saved by all these means, devote any more of this surplus time to nobler pursuits. "We don't know we are going, but we are on our way."

By reading of and profiting from the experience of others, a man may save himself many a bitter experience; by studying the relative values of life in their proper proportion, he develops judgment in human affairs; and by learning of past achievements he broadens his mind and acquires due modesty—all qualities in which the engineer has frequently been accused of being deficient. We do not here suggest the addition of general literature, history and political economy to an already overcrowded college curriculum, but most earnestly urge that they be carefully studied during a course of outside reading which should be continued through life.

The average engineer needs to realize that he is merely a man with a trade. Because of his education or rather lack of education, he is seldom a public spirited citizen, nor does he possess a broad view of things in their right proportions. He has ignored the psychology of salesmanship and advertising, he has disdained influencing crowds, and consequently he is in danger of being ignored and disdained by the crowd unless he takes a more active part in crowd activities.

Humanistic studies are a necessary means of acquiring a humanistic attitude of mind and counteract the evil of a training too exclusively scientific. The baby with his mechanical toys in the nursery, the boy with his science and mathematics in the school and the man with his machines in the factory, cannot develop a proper sense of human proportion nor discriminate as to standards of worth. Herein lies the value of literature properly correlated with science.

So let the scientist, the specializing engineer and the commercializing business man, humanize his science. Let men say amen to the pure amenities of life, let them cease to be the mere instrument of the wonderful machines they have created and let them learn to live their lives as it was purposed that life should be lived.

PERSONALS

A. F. Lloyd, salesman, Baker-Smith Company, is now in the Northwest on business.

E. W. Davies, of the Usona Manufacturing Company, is preparing for a business trip to the Northwest.

George C. Bowen has been made assistant sales manager of the Northwestern Electric Company at Portland.

T. H. Nelmes, salesman with Pacific States Electric Company, has returned from a short trip to Los Angeles.

Walter S. Levin, manager of the Railway Signal Apparatus Company of San Francisco is at Oroville this week.

F. W. Bañiche, electrical dealer of Vallejo, has returned to his city after a few days of business in San Francisco.

W. A. Ough, superintendent Plumas Light & Power Company, at Greenville, Cal., was at San Francisco this week.

W. D. Thomas, salesman of the Electric Railway & Manufacturers Supply Company, is in the San Joaquin Valley on business.

R. H. Coyne, Pacific Coast manager of the Kellogg Switchboard & Supply Company, is in Southern California on a business trip.

R. Kahn, salesman, Electric Railway and Manufacturers Supply Company, is making a business trip through Northern California.

S. P. Russell, manager of the electrical department of the H. W. Johns-Manville Company's San Francisco office, is at Los Angeles.

R. Popper, of the Interstate Electric Novelty Company, has returned to San Francisco from a business trip throughout Northern California.

Ely Hutchinson, hydraulic engineer with Pelton Water Wheel Company, is making a trip to Los Angeles, San Diego and the San Joaquin Valley.

M. A. Bryte, Pacific Coast agent of the Franco Battery & Carbon Company, has returned to San Francisco from a trip through Central California.

R. F. Oakes, president of the American Ever Ready Company of the National Carbon Company, has returned to San Francisco from a visit to the East.

A. F. Brown, salesman, Gamewell Fire Alarm Company, at San Francisco, is back from Arizona and New Mexico, where he has been for the last six weeks.

Nicholas Abrams, formerly with the Interstate Electric Novelty Company, is now in business for himself in the Western Agencies Company of San Francisco.

J. C. Nowafi, general manager, and **H. D. Pillsbury**, vice-president of the Pacific Tel. & Tel. Company, have returned from the Northwest, after looking into the telephone interests of that territory.

C. E. Hearn, who has been acting as crew manager of the appliance campaign, is back in the office of the Electric Appliance Company and has taken his old position as manager of the specialties department.

H. F. Yost has been appointed assistant manager of the San Francisco office of the Trumbull Electric Manufacturing Company. Mr. Yost was formerly in the sales department of the Electric Appliance Company of San Francisco.

D. C. Green, manager of the Salt Lake division of the Utah Power & Light Company, Salt Lake City, is attending the National Conservation Congress at Washington, D. C., which convened May 2, 3 and 4. While in the East he will spend sometime at the New York office of the Electric Bond & Share Company, and will later attend the N. E. L. A. convention at Chicago, May 22 to 26. Before returning to Salt Lake City he will spend a week at Indianapolis.

MEETING NOTICES.

Portland Sections of A. I. E. E. and N. E. L. A.

A. C. MacMicken was chairman of the April 27th meeting and the program consisted of talks on the "clean-up" campaign to be begun in Portland in May. The speakers were Jacob Kanzler, Fire Chief Dowell, Association Chief Holden, both of the Portland Fire Department, and Fire Marshal J. Stephens of Portland. Attendance 30.

Great Western Power N. E. L. A. Company Section.

Speakers for the meeting on Monday, May 8th, will be Chas. E. Mynard, assistant treasurer of the Great Western Power Company, who will speak on "Credits," and Russell D. Holabird, who will explain why the central station is giving six times as much light for \$1 as was given fifteen years ago while the price of raw material and labor has advanced 100 per cent. Mr. Holabird's subject will be: "Does the Public Comprehend that Central Station is Selling Service, Not a Commodity?" Approximately 150 well-known electrical men have joined the Bay Section, among whom are the employees of the Great Western Power Company, City Electric Company, United Light & Power Company and Consolidated Electric Company.

Electrical Development and Jovian League of San Francisco.

The luncheon of April 26th was devoted solely to the consideration of business matters. After an extended discussion a new constitution and by-laws was adopted. This makes provision for the more active participation of Jovians in league affairs, provides means for the election of tribunes and the conducting of rejuvenations under league auspices. The report of the secretary-treasurer showed the finances to be in a healthy condition. In the evening about forty members were the guests of the Coast Artillery Corps in an inspection at the armory. Great interest was manifested in the capable manner in which the men handled the 10 in. disappearing rifle and the 12 in. mortar. The remarkably complete electrical equipment of the armory excited great interest.

San Francisco Engineers Discuss Military Preparedness.

A joint meeting of the San Francisco sections of the American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers, American Society of Civil Engineers, and American Chemical Society, was held in Native Sons' Hall, Tuesday, evening, May 2, 1916. Papers presented included "Methods by Which the Civilian Engineers Can Prepare Themselves to Assist the Engineer Corps of the U. S. Army in Case of War," by Capt. Richard Park, Engineer Corps, U. S. A.; "The Work at the Military Training Camps," by Capt. John Murphy, Coast Artillery, U. S. A. (Captain Murphy is the officer in charge of the Military Training Camp to be held at Monterey, Cal., July 10 to August 5, 1916.) An outline of the Work of the Organization for Industrial Preparedness of the Naval Consulting Board, by A. H. Babcock, member of the Naval Consulting Board.

Oregon Society of Engineers.

The regular monthly meeting was held Friday evening, April 28th at Portland, thirty-five engineering students of the Oregon Agricultural College of Corvallis, Oregon, also being in attendance. President W. S. Turner presided. He called attention to the bill now pending in congress for the establishment of engineering experiment stations at Land Grant colleges throughout the United States, and a motion was made and passed "that the president and executive committee arrange to use the good offices of the society to aid in the passage of this bill."

A report was then read from O. Laurgaard, the society's representative to the National Irrigation Congress, held at Washington, D. C.

Dr. W. J. Kerr, president Oregon Agricultural College, made an address in which he discussed the engineering work of the college and its relation to the engineering work of

the state. He said in part: That the college always welcomed the co-operation of the Oregon Society of Engineers and desired to shape their courses so that they prepared the students as well as possible for their life's work. He reviewed the history of engineering courses in the colleges of the United States, pointing out in 1802 two men graduated without degrees in civil engineering from the United States Military Academy. In the following twenty-five years, 50 students were graduated in the United States from engineering courses. In 1840 Van Reneslar Institute conferred the first degree for engineering. In 1868 the first degree was conferred for mechanical engineering. In 1880 Stevens Institute conferred the first degree for electrical engineering. It can thus be seen that engineering as a profession for which a degree as such has been given, is of very recent date.

Messrs. Pater, Newell and Weber of the society discussed the subject in a general way, offering suggestions for improving engineering courses in order that the student would be better prepared for his life work. The consensus of opinion being that engineers needed more training along the lines of English, business, oratory and law, in order to equip them so that they will be able to express themselves orally and in their written reports, in a creditable manner.

San Francisco Electrical Contractors.

The regular monthly meeting of the California Electrical Contractors and Dealers was held at San Francisco April 27th. The chief topic of discussion was improving the appearance of retail stores and making better window displays, M. L. Scooby opening the discussion. C. C. Hillis suggested the value of good lighting in this respect. He also advised the contractor and dealer to sell on the basis of the market at the time of sale and not on what they may have paid for stock. This latter idea was emphasized by W. S. Berry and C. E. Wiggin.

S. V. Walton announced that the Pacific Gas & Electric Company's co-operative campaign with the jobbers would cease on May 1, so as to give the dealers a greater opportunity to do business. He spoke at length on the desire of his company to assist the dealer in every way possible.

Frank Somes gave specific examples of successful window displays.

W. L. Goodwin prophesied good times for the electrical contractor and dealer during the next two years. He urged that the contractors watch their costs more closely. He bespoke a greater interest in association activities, particularly as regards central station support.

The meeting was closed with a brilliant and effective talk on the value of the association as a means of self-preservation by Albert H. Elliot.

Los Angeles Jovian League.

Wednesday, April 26th, was celebrated by the League as Efficiency Day—at least the character of the program would indicate that such was the intention. C. B. Hall, secretary and treasurer of the Illinois Electric Company, had charge of the proceedings as chairman of the day, and furnished a well balanced and interesting entertainment. President Holland who has been away for several weeks, opened the meeting with a few remarks, and was heartily welcomed. A rapid fire of rather heated conversation followed an attempt to fine J. Harry Pieper, who was alleged to have exceeded his authority as acting chairman at the last meeting, when donations were received or rather taken from members to cover program expense. With his characteristic ready wit, he not only established his authority, but created considerable merriment with snappy repartee, which, while ostensibly extemporaneous, savored somewhat of collusion. After the fine had been rescinded and quiet was restored, the speaker of the day, Jesse D. Burks, was introduced. Holding the unique position of Efficiency Director of the City of Los Angeles, he is familiar with civic affairs and the work of the various departments of the municipality, and his talk was very interest-

ing and instructive. His theme was "Business Methods in Public Business." A musical program consisting of vocal solos by Ramona Rollins Wylie, soprano, and selections by the Jovian Singers, completed the program.

TRADE NOTES.

The Electric Agencies Company, Inc., announce their removal to 419-421 East Third street, Los Angeles, where they will maintain their offices and warehouse.

W. R. Hendrey Company announce their removal from the Armour building to 313 and 313A Hoge building, corner Second avenue and Cherry street, Seattle, Wash.

NEWS OF ARIZONA CORPORATION COMMISSION.

In the case of alleged improper toll and local exchange rates charged to the Industrial School at Fort Grant the commission ruled that all calls originating and destinating in the same zone shall be included in the local exchange rate effective for that zone, and that so long as the company's rules are such as to permit one subscriber to pay rates in more than one zone, said subscriber shall have unlimited service both inbound and outbound in those zones for which he pays.

The commission has indefinitely suspended the new schedule of rates of the Arizona, California and Nevada Telephone Company for Kingman, Ariz., pending a complete investigation.

The Arizona Power Company has been hereby authorized to issue \$30,000 of its first mortgage bonds for the use and benefit of the treasury of the company, and not less than 90 per cent of face value thereof, said bonds are a part of the first mortgage 6 per cent twenty-five year gold bonds of the Arizona Power Company, mortgaged under date of May 1, 1908, to the New York Trust Company, as trustee of which the total issue \$2,000,000, and of which \$1,892,000 are now outstanding. The maturity date of the said bonds is May 1, 1933.

The Winslow Gas, Light & Heat Company has been granted a certificate of convenience and necessity for the construction of a gas plant at Winslow, Ariz., and the certificate of the Winslow Gas Company, which has no franchise rights, has been cancelled.

The commission has issued its third annual report for the period July 1, 1914, to June 30, 1915.

INDUSTRIAL DEATHS REDUCED.

The Industrial Accident Commission has just issued figures giving the number of deaths in the industries of California during the year 1915 and draws attention to the list as compared with the statistics for 1914. In the latter year there were 691 workers killed and in 1915 533 workers gave their lives to the industries of this State. The following table shows the reductions in the death list by occupations (the word "service" includes employees of men in the professions, as well as those engaged in hotel service, apartment houses, restaurants, domestic servants and amusement or entertainment employees):

	1915	1914
Agriculture	55	62
Construction	78	115
Extraction (Mining and Quarrying).....	71	86
Manufacturing	99	121
Service	25	24
Trades	20	24
Transportation and Public Utilities.....	172	239
Unknown	13	20
Total.....	533	691

NEW CATALOGUES.

The Holtzer-Cabot Electric Company has issued a neat pamphlet tracing the progress of the company for 40 years, from 1875 to 1916.

Presto Electric Heating Appliances are illustrated and described in Catalogue No. 3 from Presto Electrical Manufacturing Company of San Francisco.

ELECTRICAL LEAGUE BASEBALL AT SAN FRANCISCO.

On Saturday, April 29th, the teams of the Electrical League met for their second Saturday battle. After a few more games the boys will be playing real baseball. The Ermsco girls are about the only rooters that have shown up in a bunch, and it is very evident that the members of the organization do not realize that their teams need their support, and if they would turn out and root for their teams, they would sure see "some" games. All three games of the league will be played on the Ocean Shore Park, at Twelfth and Mission, next Saturday, May 6th, and there are plenty of benches there for everybody, so come out and root for your team.

Electric Railway & Manufacturers Supply Company vs. Westinghouse Electric & Manufacturing Company.

The Ermsco boys bit the dust by a score of 12 to 4 at the hands of their old enemy, the Westinghouse bunch. The day was perfect, with no wind and a very fast field, but on account of numerous errors made by the Ermsco boys, the game was a little one-sided. The first inning marked a one, two, three putout for both sides, but in the first of the second the Westinghouse boys took advantage of the errors made by the Ermsco and scored five runs. No more runs were made on either side until the fifth inning, when Westinghouse brought in four more and Ermsco one. In the sixth Westinghouse made two more and Ermsco tried hard to catch up, but only succeeded in bringing in three runs. Westinghouse made one more run in the seventh, which made them 12. The Ermsco boys failed to connect, which left them at the little end of the score, with only four runs to their credit. The game was called at the end of the seventh in order that the Appliance and G. E. could have their game before dark.

Electric Appliance Company vs. General Electric Company.

Three cheers for Tommy Morgan and his bunch. Appliance beat G. E. to the tune of 12 to 3, due mostly to the very good work of Pitcher Long of the Appliance and the good support he received from his team mates.

The game was a very good one from start to finish, all the boys playing for all they had in them. The field was fast and few errors were made by either team, although the G. E. boys were not playing up to form and made a few more than usual.

The first two innings looked as though the game was going to be short and sweet, both teams putting out the first three men up. In the second half of the third the G. E. boys landed on a couple that brought in two runs for them, and in the first of the fourth the Appliance boys came right back at them and landed on the ball for three counts. The G. E. boys failed to connect in their half of the fourth, which left the score 3 to 2 in Appliance favor. In the fifth the Appliance boys succeeded in bringing five more of their boys over the rubber, while G. E. was only able to bring in one. All the boys on both sides tightened up in the sixth and neither side scored. In the seventh Appliance gave their boys another shot of hop and pulled in four more. G. E. tried hard to bring up their end of the score in the seventh, and while Tallent got a hit, the next three men up were put out, so he was left on base. This made the score 12 to 3 in favor of the Appliance boys. The game was called at the end of the seventh, as it was getting late.

Pacific States Electric Co. vs. Western Electric Co.

The Pacific States Electric Company upheld its title as league leaders, by dealing a defeat of 12 to 4 to the fast Western Electric team. The "States" heavy hitting, coupled with the Western's ragged fielding, gave the winners the best of the battle throughout. Steffens, the Western twirler, was hit rather freely, while O'Connell kept his hits well scattered, but several times during the contest the Western boys filled up the bases, either by walks, or through errors, and in each case O'Connell proved himself master, either by

striking out the next batter, or letting an easy tap to the infield for the third out. Another striking feature of the game was the playing of Kennedy, the "States" second baseman. Besides handling several difficult chances without an error, he found Steffens for two doubles, two singles and a walk in five trips to the plate. Dunning, the shortstop for the "States" boys, also starred, scoring three runs and figuring in two double plays. The work of this lad has been one of the sensations of the league. He covers a world of territory in the short field, and has proved himself an excellent lead-off man. The team as a whole has played great ball, always coming through when hits meant runs, and fielding well up to standard.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Clear Lake Suspended Monorail Company has applied to the commission for authority to engage in the business of operating a monorail transportation line twenty-four miles long, between Hopland, Mendocino county, and Lakeport, Lake county, via Kelseyville. The company is incorporated for \$50,000, of which \$26,400 has been subscribed.

The commission has issued an order authorizing the Southwestern Home Telephone Company of Redlands, San Bernardino county, to issue \$90,550 face value of promissory notes, and to use proceeds in refunding existing indebtedness. The company was also authorized to pledge \$155,000 face value 5 per cent bonds, and \$19,500 face value Redlands Home Telephone & Telegraph Company 5 per cent bonds as security for the notes.

The Clear Lake Railroad Company and the Clear Lake Suspended Monorail Company have filed with the Railroad Commission an application for an order authorizing the railroad company to sell to the monorail company all its property, for the purchaser to issue \$50,000 of capital stock, and \$900,000 of 40 year 6 per cent participating gold bonds secured by a deed of trust.

The Modesto Interurban Railway Company has filed with the commission an application for authority to borrow from the Union Savings Bank of Modesto \$4,000 on a promissory note at not more than 8 per cent, and to mortgage its property to secure this, and to issue a note for \$8 423.32 to T. K. Beard on account of money advanced the company in the sum of \$12,423.32.

Edward Cowdery, Charles Dickey and F. R. Bain, a committee formed to acquire the properties of the Southern Counties Gas Company of California, Long Beach Consolidated Gas Company, and gas properties of the Southern California Edison Company, with the exception of its Santa Barbara plant, have applied to the commission for authority to sell said property to a new corporation to be known as the Peoples Gas Company of California in exchange for \$2,750,000 par value first mortgage bonds, \$650,000 par value 6 per cent debentures and \$2,000,000 par value common stock.

PREPARATIONS FOR N. E. L. A. CONVENTION.

The thirty-ninth convention of the National Electric Light Association will be held in the Auditorium and Congress Hotels, Chicago, on May 22 to 26, inclusive. Prospects for the most successful convention in the history of the association are very bright indeed. Chairman E. A. Edkins of the hotel committee (72 West Adams street, Chicago), reports that upwards of 500 advance registrations have already been received.

T. C. Martin, secretary of the National Electric Light Association, 29 West Thirty-ninth street, New York, has issued the tentative program of papers for the Chicago convention in the April Bulletin of the association. There will be working sessions on Tuesday, Wednesday, Thursday and Friday of convention week. The committee reports and papers presented at the annual conventions of the N. E. L. A. are of the highest value to the electric service industry.



NEWS NOTES



INCORPORATIONS.

HANFORD, CAL.—Corcoran Telephone Company, \$10,000, shares \$100 each, subscribed \$300, by W. Cromlie, Delia Edenhoff and Paul Drullard.

RENO, NEV.—Union Gas & Electric Company, \$15,000, subscribed \$1000, by G. L. Fish of San Francisco, E. R. Dodge and J. R. Harrison of Reno.

PORTLAND, ORE.—The Pacific Chemical Company has been formed with a capitalization of \$300,000 by C. A. Shepard, Geo. Lovejoy and Frank E. Smith to take over the forty-year lease on Sumner and Albert Lakes held by Jason C. Moore.

CHANDLER, ARIZ.—The city water works, which has been operated by the Chandler Improvement Company has been taken over by the Chandler Water & Power Company, a corporation which has been organized with a capital stock of \$100,000. The incorporators are A. J. Chandler, W. H. Robinson, Ernest J. Koch.

FARMINGTON, N. M.—The Water Ladder Irrigation Company has incorporated with a capital stock of \$300,000. It will manufacture pumps in addition to engaging in general irrigation operations. The incorporators are Thomas S. Loftus and Volney Ervin of Farmington; Chas. R. Stedman, Augustin Morrell and Fred E. Coe of Denver.

PHOENIX, ARIZ.—Articles of incorporation of the Winslow Gas Light & Heat Company have been filed. The company proposes to operate plants for the generation of electricity, oil refineries and gas plants, and to manufacture and deal in electrical and gas contrivances, and to supply gas, oil and electric lighting, etc. The capital is \$100,000. The officers are I. J. Lipsohn, president; H. M. Harrison, vice president; M. A. Pickott, secretary and treasury.

ILLUMINATION.

SEAL BEACH, CAL.—Poles for street lighting are being set and the lighting system will be ready within thirty days.

SNOHOMISH, WASH.—Councilman Stevens has proposed that the city ascertain the cost of building its own light plant.

SANTA ROSA, N. M.—A company is being organized here for the purpose of installing an electric light plant. The chief stockholders are C. R. Jones, J. J. Moise and J. A. Ruane.

HUGHSON, CAL.—The board of supervisors will receive bids up to May 9th for furnishing the necessary lamps, appliances and electricity for lighting streets in the Hughson Lighting District.

SACRAMENTO, CAL.—Improvement leaders in Oak Park plan to revive the scheme to have electroliers similar to those in use on the main thoroughfares up town, installed along Thirty-fifth street and Sacramento avenue.

SUNNYSIDE, WASH.—For the purpose of making extensions of its lighting system near Sunnyside the Pacific Power & Light Company has made application to the Yakima county commissioners for a 50 year franchise over county roads.

POMONA, CAL.—The city council has passed a resolution declaring intention to improve certain portions of Alvarado street, Columbia avenue and certain other streets, by the installation of posts, wires, etc., for lighting them with electricity.

TRANSMISSION.

EVERETT, WASH.—The city has entered into an agreement with Robert Howes of Seattle to gather data on the power possibilities in Pulten Basin.

SPOKANE, WASH.—The Granby Consolidated Mining, Smelting & Power Company is preparing to construct an auxiliary station at its Hidden Creek properties that will increase the capacity about 7000 or 8000 h.p.

MYRTLE CREEK, ORE.—Engineer M. B. Germond of Roseburg has made his report on the proposed municipal power plant proposition. The site chosen involves the construction of a concrete dam in the Umpqua approximately 240 ft. long, a wooden flume 3200 ft. long and a power house at the end of the canal. The plant would develop from 200 to 300 h.p. The estimated cost is \$29,094.35.

SEASIDE, ORE.—Negotiations soon will be closed by the Pacific Power & Light Company for the purchase of the Seaside Light & Power Company's property in Clatsop County. The Seaside Company operates a small steam generating plant and electric distributing system and also a telephone exchange. William Pollman, of Baker, is president and F. E. Keys, local manager.

TRANSPORTATION.

CALDWELL, IDAHO.—The proposed electrification of the Oregon Short Line Railroad to Wilder by the Caldwell Traction Company will be consummated within a short time.

VISALIA, CAL.—The Visalia Electric will extend its tracks from their present stopping point, half mile below Terminus, to Point of Rocks, according to Superintendent W. P. Ballard, who has been notified that an appropriation for this work had been granted.

STOCKTON, CAL.—The Stockton Electric Railroad Company has opened negotiations for the sale of the company's properties to the city. General Manager F. W. Webster says that high taxes and increased costs consumed the profits. The company wants to sell outright.

FRESNO, CAL.—While no definite date has been announced, it is expected that laying of rails on the Fresno Interurban Railway Company's extension from the Barton vineyard to Kutner Colony will start within a month. About five of the eight miles of grading work has been completed. It is the intention to extend the line into the Centerville and Kings River country and later build the main line from a point the other side of the Barton vineyard to Clovis.

TELEPHONE AND TELEGRAPH.

NAPA, CAL.—Sealed bids will be received up to May 10th for a telephone franchise over public highways in Napa county, as applied for by Dr. Benjamin Stetson.

HERMOSA BEACH, CAL.—The Pacific Telephone & Telegraph Company was the only bidder for a telephone franchise here and it was awarded the franchise.

YREKA, CAL.—The Klamath Telephone & Telegraph Company, owned by Hessig Bros. of Beswick, has sold out to the Siskiyou Telephone Company of Etna Mills.

TEKOA, WASH.—Negotiations are under way for the construction of 20 miles of telephone line taking in Teusot and the Indian Creek territory of the Coeur d'Alene reservation.

SAN DIEGO, CAL.—The Mexican Federal telephone line being built between Tia Juana and Ensenada by Governor Cantu is nearly completed, according to David Goldbaum, who has charge of the work.

OKANOGAN, WASH.—A franchise has been granted to the Happy Hill Telephone Company to construct telephone lines along the public highways of Okanogan county. The Skyline Telephone Company has been granted a franchise also.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

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Kearns Bldg., Salt Lake City; Sheldon Bldg., San Fran-
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Bldg., Tucson. |
| A-2 Atchison, Topeka & Santa Fe Railway Co.....
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SAN FRANCISCO, MAY 13, 1916

PER COPY, 25 CENTS

FEASIBILITY OF ELECTROCHEMICAL INDUSTRIES
AT THE DALLES.
BY O. F. STAFFORD.

WATERPOWER NOT A LIABILITY.
BY C. E. GRUNSKY.

NEW TRIANGULATION SIGNAL LAMP.
BY E. F. FISCHER.

ELECTRIC-ARC FURNACE IN STEEL MELTING.
BY W. M. McKNIGHT.

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JOURNAL OF ELECTRICITY

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VOLUME XXXVI

SAN FRANCISCO, MAY 13, 1916

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FEASIBILITY OF ELECTROCHEMICAL INDUSTRIES AT THE DALLES, OREGON

BY O. F. STAFFORD.

(This comprehensive summary of Western electrochemical possibilities is a part of the general report on the Columbia River Power Project, at The Dalles, Oregon, which has been appearing in these columns during the past few months. The author is professor of chemistry at the University of Oregon, Eugene, Oregon.—The Editor.)

Introductory.

The proposal to utilize power from a hydroelectric development at The Dalles, Oregon, for electrochemical industries at once raises the usual economic problems of costs and markets, the solution

In securing the necessary data, recourse has been had to seemingly dependable published material wherever it might be found, this outline information being supplemented by many conferences and much correspondence with persons in position to give the desired



Rjukan Chemical Works, Norway, where 80,000 tons of Lime Nitrates are Annually Produced by the Birkeland-Eyde Process of Fixing Atmospheric Nitrogen Electrically.

of which must determine whether or not such industries may possibly exist as commercially successful enterprises. In the pages which follow there will be given the results of an investigation into the factors necessary for the solution of these problems for this particular case together with the conclusions which fairly may be drawn from them.

facts. There was also secured a number of co-operative contributions from men in the government departments at Washington who are able to speak authoritatively upon certain aspects of the general problem.

Due acknowledgment is to be made at this time as to the helpfulness and value of these contributions.

They were included in the original report to the project authorities, it may be said, just as they were submitted by the several contributors, but since some of them overlap the subject matter of others to a considerable extent it has been decided that for the purposes of the present article it is better to abstract these contributions and incorporate them in unified form into a general discussion.

The articles as originally contributed were as follows:

Dr. Frank K. Cameron, chief chemist Bureau of Soils, "Hydroelectric Power and the Manufacture of Nitrogen and Phosphorus Fertilizer."

W. H. Waggaman, chemist Bureau of Soils, "Hydroelectric Power with Reference to the Utilization of Western Phosphate Rock."

Messrs. E. F. Burchard and G. F. Loughlin, U. S. Geological Survey, "Northwestern Limestone Deposits."

W. C. Phalen, U. S. Geological Survey, "Western Saline Deposits."

W. H. Ross, chemist U. S. Bureau of Soils, "The Application of Hydroelectric Power to the Commercial Utilization of Potash-Bearing Minerals."

The scope of the investigation assigned to the writer includes all industries producing chemicals by the use of electricity excepting, however, those producing metals and alloys, the investigation of which formed a separate assignment handled by Messrs. D. A. Lyon and R. M. Keeney, of the United States Bureau of Mines. Since the purpose of the investigation was primarily to ascertain which of these industries, if any, could so exist as to absorb large blocks of power, no account is taken of a number of processes, which by reason of very restricted consumption of their products, obviously could not be considered as possible power consumers however successfully they might operate in a western location. Within these limitations the remaining industries to be considered are those producing abrasives, caustic and bleach, calcium carbide, chlorates, cyanides, graphite, nitrogen compounds and phosphorus compounds.

For the production of these substances relatively few raw materials are necessary, a given raw material in some instances being common to two or more products. For this reason the subject of raw material is given a preliminary consideration in this report, the discussion of manufacturing costs and market possibilities in the several industries then following under their respective headings. The particular raw materials in question are power, carbon, limestone, silica, salt, potassium, chloride and phosphate rock.

Raw Materials.

Power. Electrical energy is, of course, itself peculiarly one of the necessary "raw materials" in any electrochemical industry. The costs of electrical energy at The Dalles under the proposed project are indicated in detail in the section of this report made by the project engineer. Since the first task of the project authorities would be to utilize the primary power to be produced, all discussions to follow will be based upon the estimated cost of primary power at the generator terminals with 100 per cent load conditions at \$9 per horsepower-year. If the energy were transmitted to Portland in order to secure to an industry

the advantages of deep water transportation, the cost would be considerably higher. The distance is 85 miles; reckoning all costs attending transmission and transformation, the probable cost of energy at Portland may be taken as \$13 per horsepower-year, this figure depending, of course, upon the amount of energy transmitted, any figure approximating the one given representing the transmission of a very large block of power.

It may be said, incidentally, that in some instances this higher cost of power might well be met in order to save the transportation of raw materials up to The Dalles and the finished product back again. This would be particularly the case in the soda and bleach industry, for example, where the tonnage of materials to be taken to the plant and back is large with respect to the consumption of electrical energy per ton of product. In the discussions following, however, this possible advantage in any case is not considered, the assumption being uniformly that the industry is to be located at The Dalles.

The discussion of power costs in connection with proposed industries at The Dalles is obviously incomplete without some reference to power possibilities which might be taken up and utilized by competitive concerns elsewhere. The subject is altogether too large, however, to be treated exhaustively at this time and the most that can be said is that in all probability the development of this power would overshadow all other possibilities in the Pacific Northwest for a long time to come, as far as electrochemical industries might be concerned. It is the prevailing opinion that other smaller powers might be developed at much the same cost per capacity unit but that they would compete with so large a power once developed is not probable.

It is not the power situation in the West, therefore, which would affect the marketing of the power from the project at The Dalles for electrochemical purposes so much as the fact that in the East, where the markets for electrochemical products actually are, there is still much more power to be had at unit costs not impossibly higher than the cost at The Dalles. Power being but one item in the total cost of producing chemicals by electricity, any other advantage in an eastern locality, such as nearness to market, would permit the Eastern manufacturer to pay a comparatively high price for his power and still be even in his final costs of production. It is for this reason that the water powers in the southeastern states and in Canada, and even in Norway, stand as the obstacles to the utilization of Western hydroelectric power. It is not beyond the bounds of reason to assert that even steam-electric installations, using modern turbine units at places in the East easily served by cheap coal, might be commercially more economical sources of power for electrochemical use than western hydroelectric power.

Carbon. Both wood and coal stand as the potential sources of carbon in the Northwest.

The large area of standing timber in this territory, together with the magnitude of the lumbering industry, indicates the possibility of securing eventually a dependable supply of carbon in the form of charcoal by the utilization of the wood now wasted in the operation of logging and milling, all provided that the cost of producing this form of carbon is not greater

than the price at which high-grade coke may be obtained.

The waste in logging is especially great. At the same time the conditions for the inexpensive assembling of this waste material are particularly good, since all of the unsound trees are felled anyway under approved logging methods and together with the refuse from the sound ones could be yarded simultaneously with the bringing in of the logs to the point of loading. Actual costs for wood cut ready for charring into a retort or kiln are estimated to be \$1.25 per cord if obtained in this way. By charring the wood on the spot the product could be carried to regular transportation lines over the logging railways, and so to market, at minimum costs.

Under such a plan it might be possible to secure charcoal without by-products recovery at a figure not greatly exceeding \$7 per ton at the kiln or perhaps \$8 per ton delivered at the electrochemical plant. This estimate assumes costs of production only, no profits being allowed for.

It is known that in the South charcoal is sold to the iron industry at \$6 per ton, the charring process, however, being attended by by-products recovery. It happens, however, that the merchantable by-products from the distillation of Douglas fir, the wood most abundantly available in the Northwest, are not as great in yield as from equal quantities of selected southern wood, so that charcoal-making in the Northwest with by-product recovery has always been an industry hanging tantalizingly near the dividing line between the commercially profitable and unprofitable without ever getting comfortably over into the profitable side.

In spite of this discouraging history, however, it is not without the bounds of possibility that by-products recovery plants might be attached to simple forms of kilns or retorts set up as suggested above, right at the source of the raw materials, and yield a sufficient margin above operating costs to place the whole charring industry upon an independently profitable footing.

It appears, therefore, that the very best that might be expected in the way of a carbon supply from wood is a minimum price of \$8 per ton for charcoal delivered at the electrochemical plant.

The coal supply of the Northwest is represented by deposits, varying extremely in quality, extending from Coos Bay, Oregon, to Alaska.

The Coos Bay deposits, as well as some of those of western Washington, are sub-bituminous, non-coking coals which could have only limited use in electrochemical industries directly. These coals vary in their heating powers from 9000 to 14,000 B.t.u. per pound and cost from \$1.40 to \$2.50 per ton at the mine. The average distance from the western Washington mines to The Dalles may be taken as 260 miles with a possible eventual rate of \$1.30 per ton. The limited quantities of this cheap coal which might be used for steam, etc., could therefore be had at about \$4 per ton delivered.

Coal of suitable quality for coking is found in at least two localities in Washington. Coking operations so far have been confined to the Eilkeson-Carbonado field in Pierce county, although tests made by the U. S. Geological Survey at Denver have also established

the coking qualities of the coal from the northern part of the Roslyn field in Kittitas county. The coke from Washington, while in general use in the Northwest for foundry and smelting purposes, is not of suitable quality for the making of electrochemical products. It consequently can receive no further consideration in this report.

There are at least three coal fields lying across the Canadian boundary line which yield coke of acceptable quality for the purposes in question.

One of these is at Crows Nest Pass, a point upon the boundary line between British Columbia and Alberta. The field is upon the line of the Canadian Pacific Railway and is also tapped by a branch of the Great Northern, this latter road making possible a direct haul of 600 miles to The Dalles. This coke is said to sell currently at from \$6 to \$7 per ton at the point of production. It is not apparent, however, why profitable production of coke might not be carried on at Crows Nest Pass with sales at \$4 or even less per ton were the demand steady and large. Freight upon such an output to The Dalles should not exceed \$3, making a possible minimum of \$7 per ton delivered at the industrial site under discussion.

The other two sources of suitable coke are upon Vancouver Island at Ladysmith and Union Bay, respectively. Current prices for coke in these localities are much the same as at Crows Nest Pass, the lowest actual quotations accessible being around \$7 per ton at tidewater. Freight to Portland has been offered at \$1 per ton, making a possible price at The Dalles slightly under \$9 per ton under present conditions. Again, however, it must be the case that with a large and steady output of coke a reasonable profit should be made in the Vancouver Island collieries with a much lower selling price, a reasonable minimum being estimated as \$4 per ton. Were such a figure ever made the price of coke at The Dalles might be somewhat less than \$6 per ton.

Coal from Alaska eventually should figure in the cost estimates of coke for industries in the Northwest, since the Alaska fields are now being provided with transportation lines and the quality of the product would be undoubted. With the development of the coal producing situation in Alaska industrially there must at some time come about a condition which will compare with coal and coke producing conditions in the eastern United States. It is possible therefore to make an approximate estimate of what may be expected in time in the way of prices to be obtained for Alaskan colliery products.

Using statistical coking and transportation costs based upon present eastern conditions, but allowing the coal miner a somewhat higher price than the statistical eastern price, the cost analysis appears as follows:

1½ tons coal at \$2.20 per ton.....	\$3.30
Expenses and profits of coking.....	.60
Freight to ocean shipping point.....	.65
Freight to Portland (about 1500 miles).....	1.00
Trans-shipping at Portland.....	.15
Freight—Portland to The Dalles.....	.46

\$6.15

Such a cost analysis would apply, of course, only to conditions involving a large and steady output, but it is also true that the figure given must be a near ap-

proximation to the minimum cost at which Alaska coke may ever be delivered.

Alaska coal and coke, as a matter of fact, must always be at a disadvantage commercially compared with these same things when produced upon Vancouver Island. Industrial conditions generally should be very much the same at the two locations, so that actual production costs should be alike in the long run. The greater distance to the Alaska fields will always be a handicap, therefore, which under close competitive conditions would seriously affect the welfare of the Alaska coal industry. Upon the other hand the price of coal and coke from the Vancouver Island coal fields probably will never sink to a point representative of usual mining and coking profits until forced to do so by competition from Alaska.

With the Panama Canal in operation there remains the possibility of securing eastern coke for use at The Dalles. It is still too early for rates by ocean from the Atlantic coast to have reached the low figures hoped for and freely predicted when the canal was being promoted, so that any estimate involving ultimate rates is accompanied by great uncertainty. Applying the ton-mile rates attending the movement of coal and ore upon the Great Lakes would give for Portland a rate of about \$4 per ton from New York. Eastern coke varies in price, the statistical average for 1912 being \$2.55 at the points of production. A rounded figure for the price on board vessel at eastern seaport would therefore be \$3 per ton, making the price on vessel at Portland \$7. Predictions have been made that coal could be moved from the Atlantic to the Pacific seaboard for as little as \$2.50 per ton. Were a freight rate of \$3 finally to be effective for coke the price of the eastern article might possibly be as little as \$6, say, at Portland.

European coke of high grade has been sold in Portland for as low as \$8 per ton, and doubtless with the Panama canal in operation this price might be reduced somewhat. Quotations have also been had upon coke from the Chinese colliery at Pinghsiang at \$7 per ton f.o.b. Portland.

To summarize:

	Maximum.	Minimum.
Charcoal	\$10.00	\$8.00
Crows Nest Pass	9.00	7.00
Vancouver Island	8.00	6.00
Alaska	8.00	6.00
Chinese	7.00	7.00

It is evident, therefore, that a supply of carbon of good quality might be obtainable at The Dalles in quantity, at not to exceed \$8 per ton, with the possibility that in the course of time not more than \$6 would be paid. These are the figures to be compared with an average price of perhaps \$3.75 for carbon at Niagara Falls.

It should be stated also that in some instances anthracite coal is a form of carbon preferred for electrochemical processes. The cost of such coal at The Dalles could scarcely be less than the cost of coke if brought from the East. Anthracite from Alaska, if used upon a large scale, should be available at The Dalles eventually at a cost of about \$5 per ton.

Limestone and lime. The whole country adjacent to the Columbia River in Oregon and southern Washington is covered with a heavy deposit of basaltic rock

with practically an entire absence of limestone in any form. In Oregon there are significant deposits of limestone in the extreme northeast and southwest corners of the state, neither of these localities being accessible, however, without the expense attending a long haul over at least one mountain range in each case. The distance to the southwestern deposits is so great that no further account need be taken of them in the present discussion.

In the northeastern field there are two possibilities, one in Wallowa county and the other in Baker county near Huntington. Both have railway transportation directly to The Dalles and the distances are nearly the same, in round figures, 300 miles. The haul of lime or limestone, insofar as railway grades are concerned, might be lighter from the Wallowa deposits than from those in Baker county. There is the further possibility that lime might be produced more cheaply also at the former locality than at the latter on account of the greater availability of wood for burning. In either case the statistical freight rate of 5 mills per ton mile would make an approximate transportation cost of \$1.50 per ton to The Dalles; quarrying cost may be taken at 40 cents per ton, loading 10 cents, the price delivered therefore being \$2 per ton. If the lime were burned before shipment the cost would be \$4.30 at the kiln, estimating that there would be used one-half cord of wood at \$3 per cord and two tons of limestone to the ton of product, the other costs of production being taken as \$2 per ton. Adding to the above total the transportation estimate of \$1.50 per ton, the cost at The Dalles would be \$5.80.

There is a deposit of limestone near Roseburg, Douglas county, Oregon, of sufficient size and quality to furnish a supply of limestone for the industries under consideration. The stone could be mined at low cost, since the deposit is so exposed that a large output could be loaded directly into the cars by gravity. The distance to The Dalles is 285 miles, or practically the same as from the eastern Oregon deposits, and it is safe to say that the delivery costs of either lime or limestone would therefore differ but slightly from the above estimate.

Some high grade limestone deposits are also to be found upon the Snake River just above the mouth of the Grande Ronde. The fact that the Snake is tributary to the Columbia suggests that limestone from these deposits might be transported to The Dalles by barge lines at a low transportation cost. An objection to this plan is to be found in the navigation difficulties attending transportation of any kind upon the Snake River. The stream is not navigable for four months of the year, and at other times a number of bad rapids are to be overcome, making any dependable use of the river a matter of such uncertainty, in the opinion of men in position to know all of the circumstances, that the plan to secure a supply of lime or limestone from this source is not to be reckoned as feasible.

Much the same obstacle as in the case just discussed exists as far as limestones upon the Columbia near the Canadian boundary in Washington may be concerned. The Columbia is not adapted to use as a dependably navigable stream at this time to so great a distance.

In western Washington, however, as well as at intervals along the coast line well into Alaska, limestones are to be found which are of suitable quality. Some of these are upon islands in Puget Sound, the well-known quarries upon San Juan and Orcas Islands being examples, while others are inland or upon Vancouver Island.

The distance by water from these Puget Sound deposits to Portland is about 375 miles, a part of which is upon the open sea. Barge transportation upon a sufficiently large scale might be expected to handle limestone at a figure around fifty cents per ton, and with the possibility that the barges might be so built as to be taken on up the Columbia to The Dalles the total cost of delivery including the unloading should be well under a dollar a ton. The cost of the limestone on board barge at quarry should not be greater than 60 cents per ton so that the price delivered at The Dalles would be near \$1.50.

The transportation of burned lime by barge is said to offer certain difficulties which would make the cost per ton for the carriage alone greater than for a ton of limestone. Without definite knowledge regarding what this difference in freight cost would be it is impossible to predict the advantages of burning the lime at the quarry rather than at The Dalles. Expenses of burning the lime should be much the same at either locality so that the question eventually to be determined would be whether one ton of lime could be moved more cheaply than the two tons of limestone necessary to make it.

Assuming that the lime were burned at The Dalles with wood at \$3 per cord, limestone \$1.50 per ton and other expenses \$2 per ton of lime produced, its cost at the kiln would be near \$6.50 per ton. If lime could be moved at the same rate per ton as limestone the cost of lime burned at the quarry and delivered at The Dalles might be \$5 per ton. Lime burned at the quarry could be delivered at The Dalles by rail, with a freight rate of 5 mills per ton mile, for about \$5.50.

It seems evident, therefore, that a supply of lime for the industries in question if taken upon a considerable scale, could be assured at a figure not exceeding \$6 per ton. It is of interest to state, in this connection, that high grade burned lime is reported delivered to Niagara Falls electrochemical factories at \$4.50 per ton.

Salt. Salt deposits in the West are abundant enough, the recent investigations having for their purpose the location of possible potash saline deposits indicating that about 200 deposits of one kind or another are available for salt production. Of all of these, however, relatively few are near enough to the coast or to transportation lines of any kind to permit the delivery of salt to the coast markets at prices comparable with the prices of salt in the East. Salt ledges are known from which it would be possible to load cars by very cheap quarrying processes at costs which could scarcely be in excess of a dollar a ton, yet by the time expenses of transportation to the coast, wharfage, handling, etc., were paid the price on board coastwise schooner would be near three dollars a ton. Even the exploitation of such salt lake deposits as that of Searles

Lake, which would be worked primarily for their values in potash, borax and soda, and where the by-product salt might possibly well be given away by the operators, the costs attending the movement of the salt to the coast and loading upon a vessel would be above two dollars a ton.

It is this situation which has made possible the growth of a large solar salt industry in California. The beds are located for the greater part upon San Francisco Bay in Alameda and San Mateo counties, but solar salt is also made near Long Beach, Los Angeles county, and upon San Diego Bay. The processes yield salt at a cost which seems to have established a general value of \$2.50 per ton for the crude product in the stock pile at the works. Handling, barge tolls, and a schooner rate as at present of \$1.50 per ton to Portland will bring the price delivered at The Dalles inevitably up to near \$6 per ton. This figure might be lowered by a dollar or so were cheap salt eventually available at some such place as Searles Lake, the product being taken out by rail to San Pedro and by schooner to Portland.

The string of salt deposits referred to above, and of which Searles Lake is a member in the south, extends as far north as central Oregon, being represented there by two notably large salt lakes known as Lake Abert and Sumner Lake. These two saline deposits are within 300 miles of The Dalles and are therefore of direct interest in connection with the proposed power development because of their nearness. There are at this time no transportation lines between the lakes and The Dalles, however, so that all proposals of use of this salt at The Dalles must be contingent upon the future development of carrying facilities.

To obtain salt from the lakes in question is more than a mere matter of solar evaporation, however, since the saline content of the water is more than half sodium carbonate, considering the two lakes together. Salt production, therefore, would be accompanied by soda production also, the sale of both products being undoubtedly essential to the commercial success of any attempt to utilize these brines. The western soda market is very limited, it must be noted, and any scheme for transporting this commodity from this locality to the eastern markets in competition with Solvay soda is not to be thought of. Not even the recovery of potash salts, which exist in small amount in Summer Lake, nor the advantages of transporting the concentrated brine to The Dalles by pipe line, as has been proposed, would be sufficient to place the salt-soda industry at these lakes into a profitable condition until the industrial situation upon the coast generally advances to the point where the soda can be marketed.

The possibility of salt from an eastern source is precluded by the transportation charge. The most available eastern source probably would be Louisiana. Rock salt could be loaded upon ocean vessels relatively cheaply at Gulf ports, but with a distance of 5000 miles to Portland the freight would absorb any advantage over the somewhat higher stock pile figure at the California solar beds.

It follows, therefore, that a salt-consuming industry located at The Dalles might expect a supply of salt at

a figure eventually around \$6 per short ton, the source being either the solar beds of California or one of the inland deposits of the same state such as that at Searles Lake. The price of salt delivered to the electrochemical industries at Niagara Falls is reported to be \$2.50 per ton.

Silica. Crude forms of silica are abundant in the Pacific Northwest in the unlimited amounts of dune sand to be found upon the coast. For purposes where an impure silica might suffice, this sand would serve after a preliminary purification involving the magnetic separation of iron minerals.

Very pure silica deposits are reported at various points along the inland water-way leading from Puget Sound to Alaska. A deposit is also reported from eastern Washington, near Spokane, which appears to be of excellent quality. It is probable that silica from this locality could be delivered at The Dalles for about \$2.50 per ton.

Eastern Oregon has a number of deposits of infusorial earth of good quality as far as physical properties are concerned but which carry notable amounts of iron and alumina as impurities. One of these is located upon the Des Chutes River and only a few miles from the railroad at a distance of about 100 miles from The Dalles. It should be possible to deliver supplies of this material to the industrial site at not to exceed \$3 per ton.

Potash. Potassium chloride is of interest in this report for the reason that it is a necessary raw material for the manufacture of potassium chlorate and finds an important application in the making of mixed fertilizers.

As is well enough known, the potash market is supplied from certain unique deposits in Germany and Austria where conditions for the production of potash salts are so exceptionally favorable that under free marketing conditions all sales the world over are under the absolute control of the interests operating these sources.

This situation, amounting to complete dependence of the United States upon a foreign locality for a commodity vitally necessary to agriculture, has led to extensive investigations both by the Federal Government and by private interests into the possibilities of securing domestic sources of potash. These investigations have shown that it is possible to obtain potash from within the territory of the United States.

The most promising of the sources of supply are from leucite rock, alunite, certain western saline deposits, and from Pacific Ocean kelps. Projects are under way for the production of potash from the last three of these, certainly. How successfully they may be able to compete with German potash eventually is altogether a matter for future determination.

In any event it is unlikely that these industries will be able more than to hold their own with the powerful foreign competition they will have to meet. With this probability it is to be expected that potash supplies will cost in the future about the same as in the past which, in cargo lots at Pacific Coast ports means a figure for potassium chloride ranging around \$40 per short ton.

(To be continued.)

WATERPOWERS NOT A LIABILITY.

BY C. E. GRUNSKY.

(This communication corrects an imputation made by the California Railroad Commission that Mr. Grunsky deduced a negative value for water powers in the San Joaquin rate decision, as these unfavorable costs are not to be considered a measure of value. Furthermore, the author argues that "value" is not a proper basis for rate making.—The Editor.)

I am prompted by your publication of extracts from the recent decision of the California Railroad Commission in the San Joaquin Light & Power rate case, in your issue of April 29th, to submit a brief discussion thereof, in order that my views relating to the value of the water rights in question, may be made clear. I desire to premise my remarks by saying that I am not in sympathy with the program which makes the "present value" and the "rate-base" synonymous. I know that the courts insist that the starting point, the basis of the calculation, must be "present worth" when rates are to be fixed. But I believe that the valuation engineers and economists will yet succeed in making plain that "value" is not the proper starting point, so that the courts and the public service commissions may be permitted to cut loose from all consideration of value as the basis of rates, dealing only with investment, while yet keeping in view the value in excess of investment which the allowed earnings may create.

In the matter of the development of water power. I have only to emphasize that such development is of prime importance to society and, therefore, the public can afford to and should pay something therefor. The development should receive special encouragement and will be legitimate in many cases in which the energy obtainable from the water costs more than a like amount of energy developed by burning coal or oil. There should be a reward to the owner of the developed water power—within limits of course—for conserving natural resources. Society profits by the utilization of the water power and should consent to share with the water power owner a part of the unearned increment which he helps to create in the district in which he makes light and power available. The water right of an operating hydroelectric power plant should never be considered a liability, barring the exceptional case in which all matters, including the advantage to society, being considered, it is clearly apparent that the power development was premature and unwise. In every other case the investment deserves protection and the investor is entitled to fair compensation.

Commissioner Thelen in writing the decision in the rate case under consideration says: "It will be observed that Mr. Grunsky and Mr. Kenny both used the substitutional steam plant method but that one engineer, using this method, reports a large affirmative value for the corporation's water rights, while the other, using the same method, reports a large negative value." By using this language the commissioner makes it appear that I made the comparison of cost of developing power for the purpose of deducing therefrom the value of the water power and that I did report a large negative value. While it is true that the advantage in the matter of the cost at which energy can be produced for distribution was temporarily with

a substitutional steam plant—oil having been cheap at Bakersfield in 1913 and 1914—I did not use this fact as a basis for determining a large negative value. The deduction of a large negative value from my figures is the commission's deduction and not mine. I do not, and never have accepted the substitutional steam plant method as a dependable method of ascertaining the value of a water power.

Comparisons of power cost, generated in various ways, are legitimate, however, and deserve consideration. It is the kind of study which the engineer makes when he is called upon to advise his client whether or not to undertake a hydroelectric development.

The purtenancy of the comparison in this case, too, is apparent, because at the time that the development of power on the San Joaquin and on the Kern River was undertaken by the predecessors of the present owners, oil was worth about \$1 per barrel. No oil well had yet been drilled in the Kern River oil field and the output of oil from a few wells at Coalinga and other points in the San Joaquin Valley was an almost negligible quantity. The total oil production of the state was at that time only about 1 per cent of the present production. Furthermore, the price of oil is now about 71 cents in Bakersfield, whereas during the two years 1913 and 1914, it was but little above 50 cents per barrel. The uncertain price of oil in the future and the uncertain life of the California oil fields condemns the use of the comparison for any conclusive determination of the value of the water power.

Any conclusion, whether based on the comparison of cost of power submitted by me or whether otherwise determined that the water rights of the San Joaquin Light & Power Corporation are a liability, would be unfair to the corporation and would deserve severe condemnation. The power development made by that corporation was timely and commendable and the corporation should get not only full protection of its investment but, in addition, a fair compensation for having made the power development.

The San Joaquin Light & Power Corporation, moreover, is to be commended for its frankness in placing before the commission an unfavorable comparison of the cost of generating power, at the then prevailing price of oil, which, as the decision shows, is discussed as though it had been offered as a measure of value, instead of being treated merely as an element for consideration in fixing the value which the earnings may be allowed to create.

In this connection the following quotation from my statement before the commission in the San Joaquin Light & Power rate case relating to the comparative of cost of steam and water power will be of interest:

"The fact that at present prices of oil at Bakersfield (about 50 cents a barrel) a substitutional steam plant has some advantages over the hydroelectric plant, if the investment is to yield a return of 8 per cent per annum, in no way reflects upon the business intelligence of those who initiated the enterprise of developing the water powers on the San Joaquin Kern and Tule rivers, nor upon that of those who added new features to the established plants. The question is not, whether under present conditions as they are known for the oil fields, with due regard to the fluctuating prices at which fuel oil can be obtained, the undertaking of a similar enterprise would today be a wise business ven-

ture, but whether, all circumstances considered, the owners of the property are not entitled to the same treatment they would have received if each step taken by them from time to time had been subjected to the scrutiny, and had received the approval of a public service commission.

"At the same required earnings to meet operating costs plus depreciation and interest on the invested capital, the investment in the hydroelectric plant would be advisable:

"(a) Because it is more dependable as a permanent investment. It is free from the uncertainty of continuing usefulness resulting from a possible advance in the price of oil and the limited life of the oil field.

"(b) Because the development of a water power is in line with the true conservation of natural resources. The water used for power is replenished by nature from year to year while oil or other fuel is available in a limited supply only.

"(c) Because, while it is true that the electric company is in no position to obtain compensation for the indirect benefits which its development and especially its reservoirs confer upon the general public, the storage of water which aids in equalizing stream flow is a feature of considerable importance by reason of the resulting increase of the stream flow during the period of low water, thus conferring benefits both upon those interested in irrigation, and other users of water, all of which aid in the developing of the country and in enhancing its prosperity and growth.

"As a general proposition, therefore, there can be no question that when the alternative plants must have substantially the same earning capacity in order to yield a fair return on the investment, the hydroelectric is the more desirable and its construction should be encouraged.

"Moreover, at the time that the first development of power on the San Joaquin River and on the Kern River was undertaken, in 1895, by the predecessors of the San Joaquin Light & Power Corporation, the price of oil was at about \$1 per barrel and there was no supply of oil then available in California that would have even suggested a possible competition of steam power plants with the water powers of the Sierra Nevada streams. No such competition as hereinabove made could, at that time, have come into consideration at all."

The commission has apparently misinterpreted the purpose of a comparison of the cost of generating power. I did not, as already stated, report a large negative value of water rights and resent being made to appear as favoring the treatment of a water right of a successful operating power plant as a liability. Nevertheless, such studies as made by me in this rate case serve a good purpose in presenting a phase of the rate problem in its true light. They are, moreover, of the nature which must sometimes be employed when "strategic value" is to be demonstrated.

THE RHYME OF THE ELECTRIC RANGE.

The Cave-man ate his victuals raw,
Chewed mammoth's trunk and tiger's paw,
Ere, age by age, he nursed the flame,
That from the flashing lightning came.
That Babylonian cooked with wood,
That smoked his house and burned his food,
And drove him into sooty stews,
That roused an awful thirst for hooze.
And later yet the Baron bold
Still could not win with sword or gold
The juicy chop or well-browned roast,
That never old King Coal could boast.
We've pinched his sceptre, you and I,
We've tamed the lightning 'neath the sky,
We win the prize, and save our change—
Make way for the electric range!

A NEW TRIANGULATION SIGNAL LAMP.

BY E. G. FISCHER.

State, county and city surveyors must look to the national government for the exact geographical positions upon which to base their respective surveys. The duty to establish and furnish these positions devolves upon the United States Coast and Geodetic Survey.

The geodesist determines astronomically with the greatest possible exactness the longitude and latitude of selected principal points, suitably distributed over the whole country. The geographical positions of the many places between these principal points required are ascertained most accurately and economically by means of what is called triangulation. A rough, preliminary or reconnaissance survey reveals those points which are intervisible and most desirable as to distance and other characteristics, to form the corners of connected triangles. From the measured length of one side of a suitably selected one of these triangles and the angles of all the interconnected ones, the exact latitude and longitude of each point is computed.

Though the general principle employed in the measurement of those angles is the same as that applied in the survey of a railroad, a farm, etc., the great distance between the points, varying between ten and a hundred miles or over, requires, not only the use of specially large and refined instruments, but also a special means of making the point visible to the observer. This latter is now done, in day time, by reflecting sun light to the observer from a mirror placed accurately over the point, and at night by means of a specially constructed acetylene lamp.

It is apparent that distances of the magnitude mentioned can be penetrated by either means only under favorable weather conditions, and that many days during a season are lost even when the atmosphere is only slightly clouded by smoke, fog, etc. As the expense to maintain the party, which amounts to from \$50 to \$60 per day, goes on whether observations are made or not, it was thought that advances in illuminating devices made since the lamp now used was adopted might be utilized to increase considerably the intensity of the light directed to the observer, and thereby increase the number of observing nights.

Experiments made with calcium light produced by the oxy-acetylene flame showed this form of illumination to be impracticable by reason of cost and bulkiness of the apparatus necessary.

The storage cell was studied with the view of using electricity as a source of light. Its cost and weight and the difficulties connected with its maintenance were found to be too great. The electric generator with the necessary prime motor were carefully studied, tried experimentally and found to be too heavy for transporting to difficult stations, and doubtful as to continued and unfailing service.

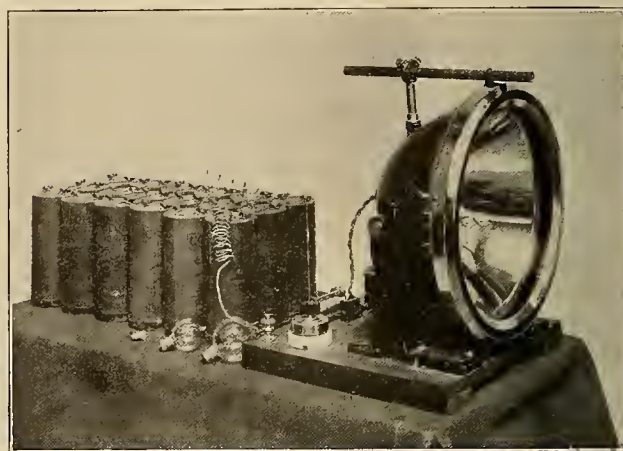
The result of a series of tests of dry cells, which are readily divisible into loads suitable for climbing difficult ascents, however, warranted the design and construction of two new lamps, the use of which, undoubtedly, will increase the present number of observing nights per month by at least twenty-five per cent.

The main part, an ordinary automobile head light, is suitably mounted for directing in the horizontal and

vertical; the lamp is provided with an ammeter, a small rheostat and a switch. The whole, packed in a strong case, weighs twenty-three and one-half pounds.

In order to obtain most nearly the maximum intensity of the light, it was necessary that the lamp bulb be provided with a filament concentrated to a degree not found in those on the market. One of the lamp manufacturers was induced to make the necessary designs and experimental tests, and submitted a number for trial.

At the present time all the lights of the stations surrounding the observer's station are kept burning



Battery Signal Lamp.

continuously from sunset to the closing of the observations for the night. The use of the dry cell was found practicable and not too costly on the assumption that the proposed lamp was to be kept burning throughout the night. The trial of the newly designed lamp by comparison with the present acetylene lamp, however, proved the former so much superior, that it was decided to have the lights shown only on signal, flashed with one of the new lamps by the observer, for the few minutes each time it is observed upon. This reduces very materially the consumption of current and battery cost.

The lamp, after being provided with two additional bulbs, one for medium and one for short distances, was tested by the Bureau of Standards, with the following results:

Apparent candlepower, at a distance of 100 ft. Lamp with specially concentrated filament, gas filled, 6 volts, 2.5 amp.	250,000
Automobile lamp, 6 volts, 1.8 amp.	50,000
Flash light lamp, 2.7 volts, .34 amp.	6,000

The candlepower of the acetylene lamp was used in the triangulation carried on by the Survey, measured under the same conditions, is 1500.

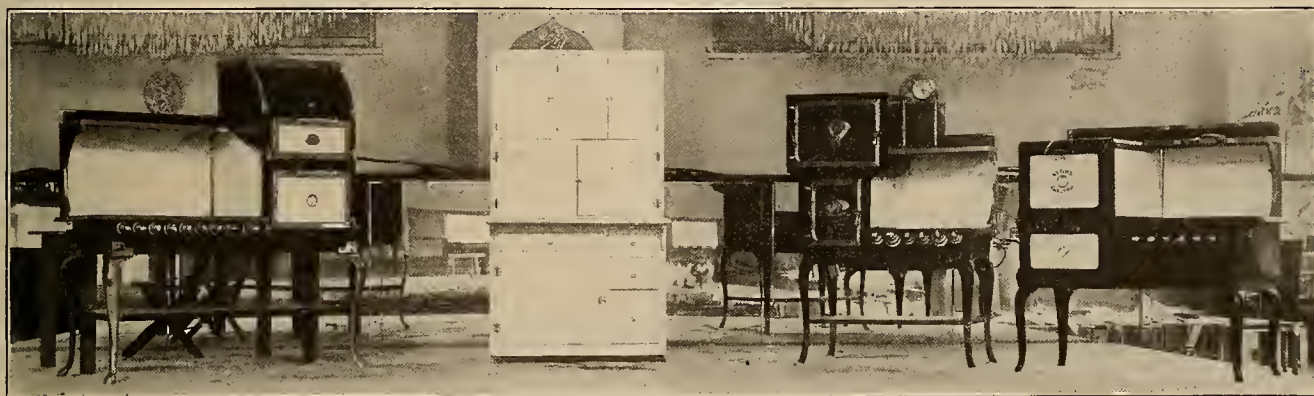
War tests of telephone and telegraph equipment, as successfully conducted by the U. S. Government May 6th and 7th, demonstrated the wonderful efficiency of the Pacific Telephone & Telegraph Company's system as well as the wonderful possibilities of the wireless telephone in maintaining communication with fleets at sea. In time of war the employees of a telephone or telegraph company, like those of a railway company, would be of greater service value at their regular occupations than on the firing line.

ELECTRIC COOKING SCHOOL AT SALT LAKE CITY.

BY B. W. MENDENHALL.

For the first time in Salt Lake City the electric range has been used exclusively in a special demonstration of cooking and cooking appliances. For several years past various manufacturers of food products and household appliances have conducted special cooking schools and demonstrations, and the gas company has always furnished the ranges used.

A cooking school held at the Auditorium, Salt Lake City, April 17 to 22, for the first time found the electric range as the star performer on the platform. The illustration shows the Hughes, Copeman and Acorn ranges which were used. The Utah Power & Light Company had a large booth in the exhibit sec-



Electric Ranges Used in Stage Demonstration.

tion of the demonstration, at which practically all of the important makes and sizes were shown, and demonstrators in attendance at all times to explain the features of the ranges and to answer any questions not made clear by the demonstrator with reference to their characteristics of operation and cost. The special lecturer engaged for this school was Mrs. Florence Osborne Chase of Chicago. While Mrs. Chase had had considerable experience with electric cooking, some of the ranges were new to her. However, with her wide, general experience, the demonstration went off smoothly. She had not had time to familiarize herself with the rates in effect in this section of the country and with the current consumption for various operations on different ranges, and was unable to answer many questions covering this feature of electric cooking. However, an excellent start was made, and the problem for the power company in some other city to induce those in charge of these lectures to use electric ranges has been simplified. As more and more of these special lecturers in household economics become familiar with the operating characteristics and special features of electric appliances for the home, their introduction will be much more rapid.

In addition to the Utah Power & Light Company the Western Electric Company and the Capital Electric Company maintained booths in the exhibition section of the school. All of the companies report that they note a much greater familiarity with electrical appliances exhibited by the public at these demonstrations than was the case a few years ago, when many of the appliances which are now common in the home were then regarded as curiosities.

MUNICIPAL LIGHTING PLANT OF SEATTLE SHOWS LOSS FOR 1915.

The Washington State Bureau of Inspection and Supervision of Public Offices has completed a check of the municipal lighting department of the City of Seattle for the year 1915. The report shows gross revenue of \$1,067,180.02; operating expense, including depreciation, \$738,007.79; interest charges and other deductions amounting to \$130,083.82; and a surplus of \$199,088.41. For 1914 the report of the lighting department shows a surplus of \$310,967.24.

In both reports failure to deduct certain items of expense has resulted in showing a greater surplus than really exists, and when lost taxes are taken into account, the plant operated at a loss in 1915. The following comparative statement shows the performance

Expenses.			
Generating:			
	1914.		1915.
Operation	\$105,117.71		\$178,630.24
Maintenance	42,366.53		33,027.35
Distribution:			
Operation	135,387.31		156,839.84
Maintenance	18,376.98		37,325.76
General expense	173,208.95		163,556.88
Total	\$474,457.48		\$559,380.07
Interest on bonds.....	\$ 84,078.20		*\$168,128.12
Total	\$558,535.68		\$727,508.19
Interest on warrants.....			**2,614.25
Total	\$558,535.68		\$730,122.44
Bad accounts	5,633.10		8,783.87
Total	\$564,168.78		\$738,906.31
Depreciation	173,257.13		178,627.72
Total	\$737,425.91		\$917,534.03
Profit and loss adjustment.....			8,785.96
Total expense	\$737,425.91		\$926,319.99

* The bond interest is given as \$100,618.49, while the accumulated bond interest for 1915 was \$168,128.00.

** Warrants drawing 5 per cent were issued for current expenses, there being no cash on hand.

Revenue.			
Private consumers:			
	1914.		1915.
Business lighting	\$238,162.00		\$254,104.94
Residence	409,441.77		423,417.01
Power	106,640.39		114,472.15
Domestic power	3,933.30		6,997.60
Miscellaneous	471.03		258.50
Street lighting paid by private consumers	4,190.77		3,949.35
Total	\$762,839.26		\$803,199.55

Municipal service:		
Business	\$ 25,483.77	\$ 26,285.85
Residence	38.75	17.25
Power	25,295.85	22,241.30
Street railway	8,780.30	11,808.62
Street lighting	221,404.47	199,994.95
Street lighting, commercial	1,636.10	.....
Total	\$282,639.24	\$260,347.97
Miscellaneous revenue:		
Motor rents (private)	2,766.85	3,440.20
Motor rents (municipal)	46.80	9.80
Cutout and other charges	101.00	182.50
Total	\$ 2,914.65	\$ 3,632.50
Total revenue	\$1,048,393.15	\$1,067,180.02
Total expense	737,425.91	926,319.99
Balance	\$310,967.24	\$140,860.03
Bonds redeemed	*50,000.00	71,000.00
Balance for reserve and contingencies	\$260,967.24	\$ 69,860.03

* Taken out of earnings to redeem bonds.

It will be noted in the above statement of expenses for 1915 that the bond interest is placed at \$168,128.12, in lieu of the amount shown in the report of \$100,618.49. The first amount represents the accrued interest on bonds outstanding for the year 1915, and includes interest on bonds of \$1,400,000 for the new Cedar River dam, which was completed November 1, 1914. The water was turned into the basin back of the dam, the banks failing to hold it, since which time unsuccessful attempts have been made to seal it. No solution of the problem has yet been found, and no engineer has been found who is prepared to say that the basin can be successfully sealed at a cost not prohibitive. The investment in this dam, including structures, to January 1, 1916, according to the report, was \$1,699,223.

While there is an apparent surplus for the year 1915 of \$69,860, this surplus disappears and a deficit of \$6850 is shown when lost taxes, amounting to \$76,710, are considered. This loss to the taxpayers is increased by an additional \$100,034, which the lower rate offered by the private company a few years ago for street lighting would have saved, making a total economic loss to the taxpayers in 1915 of \$106,884.

The gross revenue in 1915 increased over 1914 only \$18,786.87, while the expenses increased \$188,894.08.

The state report gives the cost of current at 2.959c per kilowatt hour for street lighting. The theory on which this cost is worked out is wrong, and a careful analysis and searching investigation of the figures in this report, based on 5,324,000 kw.h. consumed for street lighting, shows a cost of \$133,380.00, or 2.50c, per kw.h. The rate charged the general fund or taxpayers was 4c per kw.h., producing a profit of 1.5c per kw.h. from street lighting current. Commercial lighting and power consumers used 28,453,000 kw.h., at a cost of \$788,723, or 2.77c per kw.h. The rate of return from this service was 3.02c per kw.h., showing a profit of .025c per kw.h. In other words, street lighting showed a profit of 1.5c per kw.h. while commercial and other light and power produced only ¼c per kw.h. profit. Putting it in another way, street lighting, with a gross of \$203,944, produced a net revenue of \$70,566, while commercial and other service, with a gross of \$859,345, showed a net revenue of only \$70,620. In figuring the cost of current and arriving at the year's profit from operation, sinking fund requirements and lost taxes have not been considered, which, if taken into account, show that service has been furnished at less than cost. The charge for

street lighting has been increased from 4c to 4½c per kw.h. for 1916 to compensate for the unprofitable rate charged private consumers for service.

The average cost of all current generated and delivered from the city plant is very high. A total of 33,775 kw.h. were furnished for consumption, at a generating cost of \$372,300, or 1.1c per kw.h. This is undoubtedly a much higher cost than can be found in any plant of similar size on the Pacific Coast.

Current for power is furnished to the municipal railway, which has been showing large deficits from the beginning of operation. In order to make the best possible showing for the railway, the lighting department has been made to absorb part of the loss in the power rate allowed to it. The main substation of the lighting department delivered to the railway substations 1,574,500 kw.h. at a cost of 1.1c per kw.h., or \$17,320; substation operation and maintenance expense was \$9797; interest on substation building and equipment, \$3,716; depreciation on same, \$2,510; a total expense of \$33,342. The lighting department received in payment for this power \$11,809, and thereby absorbed a loss of \$21,534 properly chargeable to railway operation. This loss is greater than that shown by the state auditors, owing to the fact that they have failed to take into account many items of expense properly chargeable to the expense of producing the railway power.

There has been invested in the city plant up to January 1, 1916, the sum of \$6,786,257.80, against which stand bonds amounting to \$3,923,000, drawing an average interest rate of 4½ per cent. A cash depreciation reserve fund of \$49,178.36 is on deposit in banks, drawing 2 per cent interest, while warrants issued for current expenses amount to \$124,084.95, drawing 5 per cent, are outstanding.

SOME FAULTS OF THE SMALL ELECTRIC-ARC FURNACE FOR MELTING AND REFINING STEEL.

B. W. M. McKNIGHT.

(Suggestions are here given for improving the electric arc furnace. This paper was presented at the Washington meeting of the American Electrochemical Society, April 27, 29, 1916. The author is with the Southern California Edison Company, Redondo Beach, Cal.—The Editor.)

The small electric arc furnace is rapidly coming into favor for the production of small, highly refined steel castings, and its advent is welcomed by both the manufacturers of steel castings and the electric power companies. Without going into the merits of the electric furnace as a competitor of the crucible furnace and open-hearth furnace, regarding the quality of the product or regarding it as a welcome load builder for power companies, I wish to point out some of the handicaps to its universal adoption and successful operation.

The furnaces that are now in operation in several parts of this country, while differing in some respects in their mechanical construction and electrical demands, all refine the steel by the same chemical process, viz., by raising the temperature of the bath to 2500 deg. C. or better, by boiling the metal to eliminate the im-

purities, and by the introduction of the necessary refining agents to bring it up to the fineness desired.

All small arc furnaces are constructed on certain general mechanical lines, as follows: The furnace consists of a steel shell mounted on trunnions for tilting to discharge the molten metal. This jacket is lined with a highly refractory lining, sufficiently thick to retain the heat; the lining and shell, however, are pierced with port-holes for the purpose of charging the furnace with steel, adding the refining agents, discharging the refined metal and for inserting the electrodes, and all these port-holes furnish avenues of escape for the heated gases. The electrodes are secured in place by the holders mounted on the tilting shell, and the holder raises or lowers the electrode by hand operation, by hydraulic control, or by electric motor control.

Efficiency.

In spite of the fact that the electric furnace today is turning out small castings of a better quality and at a lower cost than by other processes, nevertheless, the over-all efficiency of the best furnaces on the market is far from 100 per cent.

There are three principal sources of loss:

Electrical—In the improper delivery of the energy to the metal.

Mechanical—In the improper design of the furnace shell and ports, to exclude cold air and retain the heat.

Chemical—The improper combinations of refractory materials, that should be inexpensive in first cost, withstand the intense heat long enough to avoid delays through the interruption of the manufacturing process, and not introduce any chemical combination with the metal. Also, there should be found an electrode that will not waste away too rapidly through oxidation, within and without the furnace, as it comes in contact with the air and gases.

Electrical conditions can be improved by supplying the proper current at the proper potential. Mechanical conditions can be improved by re-designing detail portions of the furnace. The chemical conditions can be improved only by exhaustive research and careful study.

Refractories.

Refractories are of two kinds: the heat-resisting linings and the heat-producing electrodes. The heat-resisting linings may be either acid or basic, depending on the degree of heat required for the quality of steel to be turned out. The heat-producing refractories may be either carbon or graphite.

Temperatures and Linings.

Merely to melt down steel scrap and turn out castings of semi-steel and low-grade castings of unknown quality does not require a temperature of 2500 deg. C., and for a furnace of this class of work an acid lining of silica is successfully used. To refine the steel, however, it is necessary to use a basic lining of magnesite, at least where it comes in contact with the bath, or where the heat would be intense enough to melt down the silica and cause it to run down into the bath and combine with the metal bath or slag and the basic lining, thereby changing their character.

The furnace linings can be put in in two ways: build up with brick work, the bricks made to conform to the shape of the shell and laid up in a basic paste or coal tar binder, or the material for the lining may be made up into a mass and rammed into the shell. The brick lining offers some advantages, inasmuch as it has passed through a glazing process that should prolong its heat-resisting qualities, but it is expensive, particularly if special sizes and shapes are desired, and if the source of supply is remote, and the delivery uncertain.

The rammed lining should be superior from the fact that it is, if properly put in, a monolithic mass, hence there should be little danger of the bath breaking through the shell, with the resulting damage to the furnace and loss of the batch.

Electrodes.

Electrodes are of two kinds: carbon and graphite. Each has its merits. The carbon electrode is the less costly, but has less electrical carrying capacity than graphite, and consequently must be greater in cross-section to deliver the same amount of energy. It therefore has a larger amount of radiating surface, and consequently the saving in first cost of the carbon is offset by the loss in energy dissipated in heat. Owing to the intense heat of the electrode, its surface both within and without the furnace shell loses carbon by its surface contact with the air and resulting oxidation.

The graphite electrode, by virtue of its greater carrying capacity, is smaller in diameter, and offers less surface for radiation of heat and oxidation. The electrode within the furnace shell is subject to further attack by the passage of the electric current through the heated gases to the lining, which, at a temperature of 2500 deg. C., itself becomes a very good conductor of electricity.

Conclusions.

Electric steel castings may not be better in quality than those turned out by skilled operators with fuel furnaces, but small electric steel castings can be made at a less cost under present conditions, which conditions could be improved, and then the furnaces will be limited only to the capacity of the source of the supply of electrical energy.

The field has apparently no limitations, if the chemist can overcome the losses I have pointed out. Formulate a better refractory lining, an electrode that will not waste away except in heating the bath, and utilize the waste gases by manufacturing them into a by-product or by-products.

I have only touched on one single product which gives promise of so much for the electric furnace. The field is undeveloped and has almost unlimited possibilities. In three Pacific Coast States alone, I am informed, there is approximately 1,000,000 horsepower in waterpower going to waste, because a too zealous government is retarding its development, by capital ready and willing to invest, if more liberal terms of lease can be secured. Such terms might be forthcoming if the American Electrochemical Society would bend its energies to make efficient power consuming devices.

This certainly is the day for the chemist, and his greatest achievements will be in the electrochemical field.

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The water power conferences at Washington, D. C., last month succeeded in convincing people that the national industrial efficiency and preparedness of America are dependent upon the early development of the water power, but failed to bring out the fact that the greatest scene for this development is in the West. Talk of a power famine is absurd when the tremendous latent water powers of the West are considered. With attention focused on the probability of governmental encouragement of air-nitrate manufacture, the fact should not be overlooked that a number of sites in the West and the South offer every inducement in the way of cheap power and strategic location. The Washington conferees seem to have overlooked their hand in this respect.

So much has been published in these columns about the development of better public relations on the

The Other Side of Public Relations

part of the public utility that there seems to be danger of overlooking the fact that the public should also be careful in cultivating better relations with the utility. It takes two to make a friendship, just as truly as it takes two to make a quarrel. And so the action of some Western cities, in particular, is creating the impression that the citizens believe "if you have any money you need not come around."

Seldom has the truism that the present success of a city's public utilities is a direct prophesy of the future success of that city been more strikingly exemplified than in the case of Cleveland, Ohio. At the last census Cleveland was the sixth city in the United States in point of population and gave promise of being the fourth city at the next census. Meanwhile Cleveland became not merely the laboratory but actually the workshop for all sorts of socialistic theories, such as three-cent car fares, a municipal electric plant, and a dog-in-the-manger harbor policy. Although a bonded indebtedness of over fifty million dollars was incurred, the sewer system is inadequate, the fire and police forces are undermanned, and only six per cent has been set aside toward a sinking fund. As a result of this political mismanagement, which is inevitably the ultimate concomitant of municipal operation, private capital has been deterred from investment in this community and present forecasts of the next census show that Cleveland bids fair to be surpassed by Detroit, a city which has encouraged private enterprise.

This is a lesson which can be profitably applied in Western cities where municipal operation of technical utilities is gradually being introduced in competition with existing companies. This form of competition is so unfair, so unequal, that in the end it leads either to a great public loss or to practical confiscation of the private plant. The single feature of state regulation of a private utility and the independence of the municipal utility is manifestly unfair. One of the principal points investigated by a concern which proposes to build a

plant in a town is how the town treats the enterprise it already has.

One of the greatest mistakes in modern municipal government, as regards the general welfare of the community, is the failure to deal fairly with public utility companies. Prosperous utilities make for prosperous cities. Any attempt to confiscate the capital belonging to men who have saved it, can only temporarily benefit those who have not saved it. If capital is to continue to help cities, its wages must be paid as regularly and as completely as are the wages of any other class making for the general good.

More dismay has been occasioned by the San Joaquin and Mt. Whitney rate decisions of the California Railroad Commission than by any ruling hitherto made by that body. This chagrin is felt not so much by the companies

A Foredoomed Experiment

directly affected as by other electric corporations who face a most serious situation if the principles here enunciated should be subsequently applied to their own affairs. The two companies immediately affected are bravely attempting the impossible and manfully trying to work out a solution.

Both the San Joaquin Light & Power Corporation and the Mt. Whitney had been serving irrigation consumers at a flat rate of \$50 per horsepower per year. In each case the commission has not only reduced this rate to \$42.30, but has given an alternative monthly graded rate whereby a farmer may have seven months' service for \$29.75. As seven months is the average period for irrigation pumping in the San Joaquin Valley, the new rate represents a reduction of virtually forty per cent in the income per horsepower of installed capacity from such irrigation consumers.

This reduction in rates, and corresponding decrease in income, comes at a time when prices for material are rapidly increasing. The costs of new construction to care for new business that might be attracted by the lower rates are almost prohibitive.

Coupled with this tremendous reduction in rate, the consumer may secure service without signing a contract or without giving any guarantee that bills will be paid, such as was formerly secured by a lien on the land. Although this ruling merely follows that laid down by the commission in other cases, it is none the less the source of considerable loss to all companies, as it removes the protection ordinarily granted to any other line of business against the "dead beat."

Heretofore, the consumer was required to grant a right-of-way across his land to obviate the cumbersome and expensive practice of following the roads laid along section lines if the next-door neighbor also desires to be served. This provision is now eliminated and the matter "left to unfettered bargaining between the customer and the utility." Any one having any experience in this regard knows that such "unfettered bargaining" is only a mild way of saying "hold up."

It is to be noted in the foregoing statement of facts that no reference has been made to disputed points in valuation, wherein allowance has been made neither for going concern value, water rights, nor franchises, no attention has been given to the great amount of development work necessary to create an agricultural pumping load, nor no argument advanced that the scheme of rate making is extremely theoretical and highly experimental. The conclusions from the facts cited are so obvious as to need no further comment here.

Notwithstanding the tremendous difficulties involved in continuing to furnish electric power at these rates, the men in charge of these companies are undoubtedly equal to the emergency. Just as the railroads, regulated to the quick by the Inter-State Commerce Commission, were almost able to cut expenses to meet the rate reductions, so the power companies will try to cut costs. But as a result service cannot but be impaired and repairs reduced to an absolute minimum. The roadbed and equipment of the railroads of the country finally were in such poor condition and their financial situation so weak that the Interstate Commerce Commission was compelled to increase the rates.

With such an example so recent and so vivid, it seems poor policy to try the same tactics with the power companies. Like many laboratory experiments it failed in practice. And ultimately the public are the sufferers.

While the law may compel men to accept rates imposed by commissions there has been no law that compels a man to continue a losing business. Here again the railroads furnish a pertinent instance: Running from the prosperous city of San Diego, California, is a little road that has been steadily losing money because of the low rate for parcel post business and because of unregulated automobile competition. Suddenly there came a flood that wiped out most of the roadbed. As losses furnish no incentive to investment, the owners wisely concluded that it was futile to throw good money after bad and abandoned the road. The people at last saw a great light. They vainly tried to raise the necessary funds by stock subscription and now have applied to this self-same railroad commission to compel the owners to rebuild. The commission has not yet decided what should be done but reason would suggest that unless the parcel post rates are raised and automobile competition regulated the owners should not be compelled to re-invest in a losing proposition. Another branch road, running to Yreka, California, confronts the same trouble, without the providential relief of a flood in sight. The delay due to freight loaded on as mail makes it possible for jitneys to give better passenger service.

The experience of the railroads is indicative of the condition confronting the electric companies. In the light of these other experiments in railway rate tinkering which have so signally failed, why repeat them with the electric power companies?

PERSONALS

W. D. Steele, vice-president of the Benjamin Electric Company, is at Seattle.

Earl G. Wilson, electrical dealer from Napa, was at San Francisco this week.

S. B. Gregory, Pacific Coast manager for the Arrow Electric Company, is at Los Angeles.

D. E. Bailey of the Bailey-Drake Company has returned to San Francisco from Los Angeles.

Clarence Rylander of the Western Electric Company has returned to Seattle from San Francisco.

H. E. Sanderson, representing the Bryant Electric Company, is in the Northwest on a business trip.

Chas. Northcutt of the Modesto Electric Light & Gas Company of Modesto, California, is at San Francisco.

A. F. Flannagan, manager Electrical Engineer & Supply Company, Stockton, was at San Francisco this week.

H. G. Levy of the Electric Manufacturing Company is making a business trip to Los Angeles by automobile.

Henry F. Yost of the Trumbull Manufacturing Company is at Sacramento on his first trip for the above company.

Gerard Swope, vice-president and general sales manager of the Western Electric Company is at the Yosemite Valley.

C. J. Winslow, salesman Electric Appliance Company, has returned to the San Joaquin Valley from San Francisco.

L. E. Sperry, agent for W. N. Matthews & Co., Bros., Inc., has returned to San Francisco from a trip in Northern California.

J. F. Macpherson, general auditor of the Federal Sign System, with headquarters in Chicago, will be at San Francisco next week.

W. I. Ot's, representing the Detroit Fuse & Manufacturing Company and other companies, left San Francisco last week for Southern California.

H. D. Aylsworth of the Aylsworth Agencies Company of San Francisco, left for the East via Los Angeles last week and expects to be gone at least a month.

C. H. Hunt, Pacific Coast manager of the Robbins & Myers Company, has returned to San Francisco from a short business trip to Los Angeles.

K. Muzutani, former secretary of the Japanese Commission at the P. P. I. E., will represent the Bailey-Drake Company in Japan. With him will be Wm. Finnigan.

L. B. Van Atta, of the sales department of the Pacific States Electric Company, is back at his desk again after a campaign of appliances in the territory between Oakland and Chico.

Chas. N. Black has resigned as vice-president and general manager of the United Railroads of San Francisco to devote his time to the work of Ford, Bacon & Davis, of which firm he is a member.

B. A. Wagner, manager of the Electric Agencies Company, and **N. Abrams**, manager of the Western Agencies Company, have returned to San Francisco from a week's fishing trip in Mendocino county.

Paul Butte of the Butte Engineering Company has returned to San Francisco from Walnut Grove, where they have been installing the electric system on the county bridge over the Sacramento River.

W. D. Thomas, salesman for the Electric Railway & Manufacturers' Supply Company, has returned from a trip to the San Joaquin Valley, while **Raymond Kahn** of the same company is back from the Sacramento Valley.

J. Peterson, electrical engineer of Christiana, is at San Francisco, en route to China and Japan. He has been visiting most of the large electrical plants throughout the East and will make scientific investigations in the Orient.

Albert Meinema, city sales manager of the Electric Appliance Company at San Francisco, said that the demonstration of electric ranges at the Oakland Motor Show has produced such good results that they are entirely out of ranges.

C. W. Cowles, former electrical dealer and contractor of Red Bluff, California, has sold out his contracting and supply business in Red Bluff and entered the employ of the U. S. Navy Department as electrical expert aid, being stationed at Bremerton, Wash.

Wm. Jacobs, representative of the Santa Cruz Chamber of Commerce, who is at San Francisco, announced that arrangements had been made for the installation at Santa Cruz of a battery of scintillators such as were utilized at the P. P. I. E., which will make surf bathing possible at night.

E. Murray, salesman for the Western Electric Company, is back from a trip to Southern California. **W. Todt** of the same company leaves this week for the northwestern part of the state. **W. B. Lewis** leaves for Nevada and Northern California, while **Frank Du Frane** is in the southern part of the state.

Morril N. Farr, formerly in the electric service department of the Utah Power & Light Company and **P. J. Diebold**, formerly in the manufacturing department of the Capitol Electric Company, have resigned their positions and have incorporated the Farr-Diebold Electric Company with offices at 24 Richards street, Salt Lake City.

R. S. McClelland, chief engineer Electric Bond & Share Company of New York, was at San Francisco the past week discussing with local engineers the proposed Electrical Safety Code of the U. S. Bureau of Standards, as well as the subject of inductive interference and the selection of insulators to minimize failure. He is returning East via Salt Lake City. At Chicago, May 29th and 30th, following the National Electric Light Association convention, there will be a meeting of engineers to discuss these several matters.

OBITUARY.

Enos M. Barton, one of the founders of the Western Electric Company and for twenty years its president, died at his southern home in Biloxi, Miss., May 3, 1916, at the age of seventy-two years. Since his retirement from the presidency of the company in 1908, he had been chairman of its board of directors.

MEETING NOTICES.

Electrical Development and Jovian League.

The May 3d meeting was characterized by a spirit of even more than ordinary good comradeship, brought about, it is thought, by new quarters in the Palace Hotel. Sam Hamilton, as chairman "emergent," provided good entertainment and a fine speaker in Dr. Philip Jones, secretary of the State Medical Association, who told of pending legislation on industrial health insurance.

Illuminating Engineering Society.

The tenth annual convention of the Illuminating Engineering Society will be held in Philadelphia, September 18, 19 and 20. Immediately following the convention there will be given at the University of Pennsylvania under the joint auspices of the University and Society a course of twenty lectures on the theoretical and practical aspects of illuminating engineering. The lectures will be given by eminent authorities in the lighting world and will take approximately eight days.

Oregon Electrical Contractors' Association.

The Oregon Association of Electrical Contractors and Dealers now have a membership of 59 regular and three associate members. During "house wiring month," from March 15 to April 15, 1916, 185 already built houses were wired, the E. L. Knight & Company being the prize winners with 38 wired. So well pleased are all taking part that it is proposed to put on another and greater campaign in the

fall. Mr. Carpenter of the Meler & Frank and J. C. English were the principal speakers at the educational meeting held on April 12th, the subjects were merchandising and figuring profit.

San Francisco Section American Society of Mechanical Engineers.

At a meeting on April 20th at the Engineers' Club, D. E. Keppelmann of the Pacific Gas & Electric Company gave an interesting account of oxy-acetylene welding as employed by his company for joining high pressure gas mains. This company has a 16 in. main through the heart of San Francisco from the Potrero to North Beach and an 8 in. transmission main encircling the city. Asbestos or rubber gaskets were used in the former at a cost of about \$4 per joint, with a subsequent high cost of maintenance because of joint leakage. The same couplings on a 16 in. pipe with the oxy-acetylene process costs \$2.50, with no further expense. Consequently this process has been adopted in the latter case. Mr. Keppelmann's talk was illustrated with lantern slides which showed full details of the process.

Los Angeles Jovian League.

Chauncey T. Carr, heating device specialist with the General Electric Company, was chairman of the day at the luncheon on May 3d, and furnished an excellent speaker, a big entertainment, and also introduced a number of laughable and entertaining innovations which created much merriment, and were heartily enjoyed. The speaker of the day was Dr. Arthur S. King, superintendent of the physical laboratory of the Mount Wilson Observatory. His subject was "The Equipment and Method of Work at the Mount Wilson Solar Observatory." He described the new 100 in. telescope now under construction, which will be used for studying the solar spectrum and for observing celestial phenomena. This telescope, the largest instrument in the world, has moving parts which weigh one hundred tons; the lens alone weighing five tons. He described the many ingenious electrical devices used in connection with the various instruments, and stated that fifty and twenty-five horsepower units with remote control were used in connection with the telescopes, the power being generated on the mountain. The Mount Wilson Solar Observatory, which is endowed by the Carnegie Institute of Washington, is the most modern of all astronomical institutions in point of method and equipment. An invitation to visit the observatory was extended to the members of the league. A novelty musical number by Zoe Wallace, singing comedienne, concluded the program.

A. I. E. E. National Meeting.

On May 16th a national meeting of the American Institute of Electrical Engineers, to commemorate the achievements of its members in the fields of communication, transportation, lighting and power, will be held jointly in San Francisco, Chicago, Atlanta, Philadelphia, New York and Boston by long distance telephone service. All of the auditoriums in which the meetings are held will be connected by telephone circuits, and every seat in each hall will be provided with a telephone receiver so that everyone in attendance will be able to hear the proceedings in each of the participating gatherings in other cities in turn.

The President of the A. I. E. E. will preside at New York and there will be a local presiding officer and principal speaker at each of the other cities. The meeting will be opened by President Carty who will address all the above cities simultaneously by telephone, following which will be greetings by prominent members of the Institute in different parts of the country, and other proceedings of interest conducted by telephone. The second part of the program will consist of an address by the principal speaker in each city to the local audience only, and will occupy about 30 minutes.

At the close of the simultaneous addresses, telephone greetings will be transmitted from each city to all of the other gatherings, and musical selections will be rendered

by telephone between the different cities. Local orchestras will provide music at the various meetings which will not be transmitted by telephone.

REGULATION OF TELEPHONE COMPANIES IN UTAH.

The first step toward the regulation of public utility corporations in the state of Utah has been taken by the Board of County Commissioners of Salt Lake county within, which county Salt Lake City is located. The commission has enacted an ordinance providing that all charges for telephone service shall be just and reasonable and every unjust or unreasonable charge made shall be prohibited and declared unlawful. Service, equipment and facilities shall be furnished by every telephone company to promote the safety, health, comfort and convenience of its patrons, employees and the public. Every telephone company operating within the county must file with the board of county commissioners within sixty days of its passage a schedule of all rates together with all rules and regulations pertaining to rates. The rules and regulations made by any telephone company must be just and fair.

Schedules of rates filed by any telephone company shall not be in excess of the rates in effect by it on March 1, 1916. No change shall be made in any schedule of rates or service classification, nor shall any rule or regulation be changed unless so ordered by the board of county commissioners. Every telephone company in the territory affected by the ordinance must receive and transmit messages from other telephone companies with the lines of which connections may have been made or have been ordered by the board of county commissioners.

Upon finding that any rate is unjust or unfair the board of county commissioners may determine a just and fair rate for service and the telephone company concerned shall observe such action of the board and operate in conformity therewith. The passage of this ordinance is the outcome of a controversy between the Mountain States Telephone & Telegraph Company and its patrons over the matter of toll charges between exchanges in Salt Lake county.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Fontana Power Company of San Bernardino county has filed with the commission an application for authority to go into business as a public electric utility, to build a power plant and transmission system, to sell \$350,000 worth of bonds, and to mortgage its property to secure this issue. The company also proposes to lease its properties to the Southern California Edison Company for thirty years.

The Imperial Telephone Company and the Pacific Telephone & Telegraph Company have filed with the railroad commission a joint application for authority for the Imperial Company to sell to the latter its entire system for \$165,643.67.

The Mt. Whitney Power & Electric Company has filed with the commission an application for authority to issue 450 bonds of \$1000 each, at 6 per cent interest, payable semi-annually to reimburse it for expenditures made primarily in the purchase of consumers' transformers.

The San Francisco-Oakland Terminal Railways has filed with the commission an application for authority to issue promissory notes for \$180,000, in denominations of \$1000 and \$500 each at 6 per cent, callable at 100½ and interest on 60 days' notice, and maturing between 1917 and 1925.

NEWS OF OREGON PUBLIC SERVICE COMMISSION.

With the merging of the Coos & Curry Telephone Company and the Coquille Valley Telephone Company, under the former name, the consolidated system has filed application with the commission for authority to make increases in rates for service for all the territory covered by its lines. The commission will investigate the conditions existing before passing upon the application. The company operates in Marshfield, Coquille and Myrtle Point.

PACIFIC GAS & ELECTRIC COMPANY'S NEW POLICY REGARDING SALE OF ELECTRIC APPLIANCES AND RANGES.

With the termination of the electric appliance sales campaign that has been co-operatively conducted by the Pacific Gas & Electric Company and the electrical supply jobbers, comes announcement of new plans. The sale of socket appliance will be actively taken up by the local dealers and the company will pay the dealers a premium of fifty cents for each appliance sold and will assume installment contracts when the credit of the purchaser is approved by the district manager.

As regards the sale of electric ranges and water heaters tentative arrangements are being made. In districts where dealers satisfactorily demonstrate their selling ability the company will not enter into active competition and will bear the cost of connecting ranges old sold to consumers on existing lines. It will further aid dealers by co-operating with them from time to time in conducting cooking demonstrations, the company furnishing a competent demonstrator, supplies and space for demonstration to be furnished by the dealer. Dealers will be expected to maintain an attractive display of ranges and water heaters and to advertise electric cooking by distributing literature and by newspaper advertising.

In territory where dealers do not take up actively the sale of ranges the company will do so. This company's sale prices are based on an advance of 25 per cent on the price f.o.b. San Francisco, subject to a discount of 10 per cent for cash. Installment terms, 10 per cent down, balance in ten equal monthly payments.

Where dealers sell ranges in accordance with the prices established by the company it will arrange to relieve the dealer of installment contracts, where the purchaser's credit is satisfactory, by paying the dealer the cash price established by the company and collecting from the purchaser the installment price, retaining the difference of 10 per cent as compensation for the accommodation.

TRADE NOTES.

The H. B. Squires Company has opened a branch office in Seattle at No. 309 First avenue, South, with Mr. T. N. Bristow, late of the Westinghouse Company, in charge.

The Electric Agencies Company is building a new sales-room just above the present location at No. 247 Minna street, San Francisco, to accommodate more business. The Western Agencies Company will occupy one-third of the space in the new building.

The Central Electric Company of San Francisco had the lowest figure in the electric wiring and equipment for Engine House No. 8, their bid being \$994. The Turner Company was the next with \$1178. Roberts Manufacturing Company took the fixture contract on the job for \$897.

The American Electrical Engineering Company was the successful bidder on the electrical wiring equipment for the two Myers buildings just erected at Bush and Van Ness avenue, San Francisco. This is one of the largest wiring contracts completed for some time, amounting to \$915.

The Bailey, Drake Company, San Francisco, has taken over the Luminous Specialties Company's line, whose home office is at Indianapolis, Ind. This company has also gone into the export business in earnest. They now have resident salesmen in Japan, China, the Philippines, Australia and New South Wales.

Ralph Clapp has sold his interest in the Drake-Clapp Electric Company of Los Angeles to A. G. Drake and has established offices in the San Fernando Building, Los Angeles, as representative of the American Circular Loom Company, Stanley & Patterson, Electrical Engineers Equipment Company, Wisconsin Electric Company, etc.

The Western Agencies Company recently organized in San Francisco with offices and stockrooms at 249 Minna street, is representing a number of well known manufacturers of lamps, flashlights, auto specialties and other similar materials. The president and manager of the company is Nicholas Abrams, formerly connected with the Interstate Electric Novelty Company, and who is widely known among the trade throughout the entire western territory.

The Standard Underground Cable Company announces the following changes in the locations of several of its branch offices: The Chicago office is now located in the Conway Building, having on May 1st moved from The Rookery where it was located for many years. The Detroit office has moved from the Free Press Building to the Whitney Building. A new office will shortly be opened in Minneapolis, Minn., in charge of W. J. Weld. In the Pacific Coast Department the Portland, Ore., office has been discontinued and a new office opened in the Newhouse Building, Salt Lake City, Utah, in charge of F. W. Wilson.

ELECTRICAL BASEBALL LEAGUE.

On Friday night, May 5th, the Electrical Baseball League of San Francisco held their benefit dance at Maple Hall, and from the large crowd in attendance and the good time enjoyed by all, it can easily be said that it was a great success, socially as well as financially. There were over 250 in attendance.

Ermsco vs. Western Electric.

The fast Western boys now have another feather in their cap after trimming the Ermsco boys in a 12 to 4 contest. The game was rather late in getting started, but both teams played fast and furious, and the result was one of the fastest games that has ever been played in the League. Only eight innings were played, but these were finished in one hour and twenty-five minutes. The pitchers of both teams did very good work. Steffens of the Western struck out 12 of the 42 men that faced him and only walked 2, while Finley of the Ermsco struck out 12 of the 40 men that faced him and only walked 2. Western started the game off to their advantage, the first man up getting a hit, and coming in for the first run. The first three men up for Ermsco failed to reach the sack. The second inning neither side scored, but in the third both teams succeeded in landing a man over the home plate, which made the score 2 to 1 in Westerns favor. In the fourth there two hits made by each team, but neither was able to make them count. In the first of the fifth Ermsco got another run which tied the score, but the Western boys seemed to get the drop on the ball in their half of the fifth and galloped five men around the bags. They got four more in the sixth and one in the seventh, and then Ermsco came to life and made two runs in the eighth, which ended the game with a 12 to 4 score.

Pacific States Electric and General Electric Game.

The game was started promptly at 2 p. m. at Ocean Shore grounds and was a game full of "pep," but teams having an object in view, the States to uphold their title as "League Leaders" and the G. E. boys in their attempt to crawl out of the cellar. "Co-operation," in another form, namely—good team work—and good support from a large rooting section, were two of the chief reasons for the Pacific States Electric Company's team upholding their title as "League Leaders," when they defeated the General Electric Company's team to the tune of 11 to 4.

The "States" boys showed their best form in their good fielding and also brought up their batting average when they found both of the G. E. twirlers. A sensational home-run was hooted out by Fred Kaiser whose long legs easily carried him around the bags and then some.

The G. E. boys tried hard to dig their way out of the cellar and showed some very fast in-field work.



NEWS NOTES



ILLUMINATION.

LOS ANGELES, CAL.—The city council has voted to light Adams street between Grand avenue and Figueroa with the same kind of lights as will be used on West Adams street.

HUNTINGTON BEACH, CAL.—The city trustees are negotiating for the installation of 300 additional ornamental lamp posts to be installed throughout the residence district.

BRAWLEY, CAL.—Estimates on new lighting systems have been presented to the city commission. There are two plans. One calls for an expenditure of \$2074 and the other \$1124.

LOS ANGELES, CAL.—The city council has ordered the necessary ornamental lighting posts and appliances installed and maintained for a period of one year for lighting Hollywood Boulevard.

COTTONWOOD, IDAHO.—B. L. Sivyer states that the Grangeville Electric Light & Power Company intends constructing a big electric light and power plant on the Clearwater during the summer.

POMONA, CAL.—A resolution of intention has been passed by the council ordering cast reinforced concrete posts, wires, conduits, lamps and appliances for street lighting installed on portions of Alvarado street, Columbia avenue, and Jefferson avenue.

REDONDO, CAL.—The city engineer has been instructed by the council to start proceedings for the installation of ornamental lamp posts along Catalina avenue from Opal to Pacific, on Pacific from Diamond street to Opal, on Diamond from Pacific to Camino Real, on Camino Real from Diamond to the city limits.

FULLERTON, CAL.—Interest in an ornamental lighting system was renewed here when it became known that the city council had received an offer from a Los Angeles concern to place electroliers on Spadra and Commonwealth avenues. The plan calls for the installation of 134 lights at a cost of \$1.30 a front foot.

NOVATO, CAL.—The Pacific Utilities Company has petitioned the supervisors for a 25 year franchise to serve the township of Novato with electric light, power, water and telephones. The company is a \$50,000 corporation, with R. H. Trumbull, A. D. Scott, Frank Silva and the Cain Bros. as directors and stockholders.

NEWPORT BEACH, CAL.—The city trustees have signed a contract with the Southern Counties Gas Company for distributing natural gas from the Standard Oil Company fields near Fullerton. The contract calls for a four-inch pipe line to be laid from Garden Grove to the city limits. Construction of the new line will begin at once and will be completed within sixty days.

LOS ANGELES, CAL.—Proceedings for installation of an ornamental lighting system in Hobart Boulevard have been held up by property owners who presented a petition to the council for the use of marbelite light standards instead of the cast iron type proposed. Proceedings have been continued two weeks to permit property owners to get together and agree upon the type of light post to be used.

BANNING, CAL.—The stockholders of the Banning Gas & Lighting Company have accepted the proposition of a Los Angeles company to purchase the plant. The Los Angeles people plan to take over the Beaumont plant also, and supply the two cities from one plant. Stock in the new plant would be taken by the people who have stock in the present gas companies. It is said that the deal is quite likely to be closed and the gas plants of the two cities will undergo extensive improvements.

TRANSMISSION.

SAN FRANCISCO, CAL.—The City Electric Company will erect a two story brick substation on North Bush street west of Grant avenue to cost \$90,000.

SPOKANE, WASH.—Renewed mining activity is reported in the Princeton District of British Columbia. It is stated that the British Columbia Copper Company will install a power plant this spring.

VISALIA, CAL.—A new 33,000 volt transmission line is being erected between Visalia and Exeter by the Mt. Whitney Power & Electric Company. The line represents an expenditure of close to \$30,000. Sixty foot poles are being used to carry the line above the other lateral feed lines.

RIVERSIDE, CAL.—Chas. H. Dehacour has applied to the board of supervisors for a franchise to erect and maintain for a period of fifty years a pole-tower and wire system for transmitting electricity along certain roads of Riverside county. Sealed bids will be received for the franchise up to May 17th.

TELEPHONE AND TELEGRAPH.

SALINAS, CAL.—The board of supervisors has granted permission to Charles and Henry Bardin to construct a telephone line along the county road to their Gabilan ranch.

SANTA BARBARA, CAL.—Engineers of the merged telephone company here are busy preparing plans and specifications for the work which must be completed before the two systems are consolidated on June 1.

LOS ANGELES, CAL.—The People's Telephone Committee has filed with the city clerk a petition urging the council to adopt or submit to the people an ordinance providing for an \$8,000,000 bond issue for the establishment of a municipal telephone system in Los Angeles.

TRANSPORTATION.

SAN FRANCISCO, CAL.—The board of supervisors has directed the board of works to go ahead with the Church street car line and has also started proceedings for the laying of tracks on Market street from Church street to Twin Peaks tunnel and from Van Ness avenue to Kearny.

SALT LAKE CITY, UTAH.—Announcement has been made by General Manager Joseph Nelson of the Salt Lake & Los Angeles Railway Company that final and definite arrangements have been perfected for the electrification of the company's line which operates between Salt Lake City and the Saltair Beach pleasure resort, fifteen miles west of the city; also that the company will extend its line from Saltair to Garfield, a distance of three miles. Ties, rails and the other equipments necessary for this extension have already been ordered and work will begin in the near future. Preliminary work on the electrification of the main line to Saltair has been begun. At the half way passing point over an additional mile of passing track has been put in. When the road initially electrified it will be operated as a single track line with long double track turnouts at passing points and these will gradually be extended until the entire line is double track. General Manager Nelson announces that arrangements have been completed with C. F. Childs & Company of Chicago to finance the Garfield extension and the electrification of the line. Engineers and financial representatives of that company have made exhaustive investigations of the property by whose recommendations the company were so favorably impressed with the property as to enter into the contract to finance it. H. A. Strauss, the consulting engineer with offices in the Harris Trust Building, Chicago, has been engaged to prepare plans and specifications for the electrification.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

- A-1 American Ever-Ready Works of National Carbon Co..
Los Angeles; 755 Folsom St., San Francisco; Seattle.
- A-2 Atchison, Topeka & Santa Fe Railway Co.....
673 Market St., San Francisco; 1218 Broadway, Oakland.
- B-1 Baker-Joslyn Company.....
71 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 E. Second St., Los Angeles.
- B-2 Benjamin Electric Manufacturing Co.....
690 Howard St., San Francisco.
- B-5 Bridgeport Brass Co.....
(See Pierson, Roeding & Co.)
- C-1 Century Electric Co.....
906 So. Hope St., Los Angeles; 56 Natoma St., San Francisco; 65 Front St., Portland, Ore.
- C-3 Crocker-Wheeler Co.....
Crossley Bldg., 618 Mission St., San Francisco; 228 Central Avenue, Los Angeles.
- C-4 Cutler-Hammer Manufacturing Co.....
579 Howard St., San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.
- D-4 Davis Slate & Manufacturing Co.....
Chicago, Ill.
- D-2 Dearborn Drug and Chemical Works.....
355 East Second St., Los Angeles; 301 Front St., San Francisco.
- E-7 Economy Fuse & Mfg. Co.....
Kinzle and Orleans Sts., Chicago.
- E-1 Edison Lamp Works of General Electric Co.....
Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles.
- E-2 Edison Storage Battery Supply Co.....
441 Golden Gate Ave., San Francisco.
- E-3 Electric Agencies Co.....
247 Minna Street, San Francisco; Central Building, Los Angeles.
- E-6 Electric Novelty Works.....
633 Mission St., San Francisco.
- E-4 Electric Storage Battery Co.....
743 Rialto Bldg., San Francisco.
- E-5 Electric, Railway & Manufacturing Supply Co.....
34 Second St., San Francisco.
- F-1 Fairbanks, Morse & Co.....
Los Angeles; Portland; 651 Mission St., San Francisco; Seattle; Spokane.
- F-3 Federal Sign System (Electric).....
618 Mission St., San Francisco.
- G-1 General Electric Co.....
724 So. Spring St., Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.
- G-1 General Vehicle Co.....
1117 Van Ness Ave., San Francisco; 331 Wall St., Los Angeles; British Columbia Electric Ry., Ltd., Vancouver, B. C.
- H-1 Habirshaw Wire Co.....
(See Western Electric Company.)
- H-2 Hemingray Glass Co.....
236-240 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco.
- H-5 Hunt, Mirk & Co.....
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- H-7 Hurley Machine Co.....
New York and Chicago. (See Pacific States Electric Co.)
- I-2 Illinois Electric Co.....
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- L-1 Leahy Manufacturing Co.....
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- L-2 Locke Insulator Manufacturing Co.....
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- M-2 McGlaughlin Manufacturing Co.....
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- M-4 Morse Chain Company.....
Monadnock Bldg., San Francisco.
- M-3 Moore & Co., Charles C.....
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- N-6 National Carbon Company.....
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- N-2 National Conduit & Cable Co., The.....
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- N-3 National Lamp Works of G. E. Co.....
(All Jobbers.)
- N-4 New York Insulated Wire Co.....
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- N-5 Northwestern Pacific Railroad.....
808 Phelan Bldg., San Francisco.
- O-1 Okonite Co. (The).....
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- P-1 Pacific Electric Manufacturing Co.....
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- P-4 Pelton Water Wheel Co.....
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- P-5 Pierson, Roeding & Co.....
Pacific Electric Bldg., Los Angeles; Rialto Bldg., San Francisco; Colman Bldg., Seattle.
- P-6 Pittsburgh Electric Specialties Company.....
202 Aronson Bldg., San Francisco.
- P-7 Pittsburgh Piping & Equipment Co.....
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- S-1 Schaw-Batcher Company, Pipe Works, The.....
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Flood Bldg., San Francisco.
- S-5 Sprague Electric Works.....
Rialto Bldg., San Francisco; Colman Bldg., Seattle; Corporation Bldg., Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane.
- S-6 Standard Underground Cable Co.....
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Yeon Bldg., Portland; Central Bldg., Seattle, Wash.
- T-1 Thomas & Co., R.....
Pacific States Electric Co. and Western Electric Co., Pacific Coast Representatives.
- T-2 Tubular Woven Fabric Company.....
Pawtucket, R. I.
- U-1 Union Sheet Metal Works.....
575 Howard St., San Francisco.
- W-1 Wagner Electric Manufacturing Company.....
St. Louis, Mo.
- W-2 Western Electric Co.....
Eighth and Santee Sts., Los Angeles; 1901 Telegraph Ave., Oakland, Cal.; 680 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore.
- W-4 Westinghouse Electric and Manufacturing Co.....
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; 165 Second St., San Francisco; Second and Cherry Sts., Seattle; Paulsen Bldg., Spokane.
- W-5 Westinghouse Machine Co.....
141 Second St., San Francisco.
- W-6 Westinghouse Lamp Co.....
(See Westinghouse Electric & Manufacturing Co.)
- W-8 Western Pipe & Steel Co.....
444 Market St., San Francisco; 1758 North Broadway, Los Angeles.

JOURNAL OF ELECTRICITY

POWER AND GAS

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ELECTRICAL ENTERPRISES IN JAPAN.

AN ANSWER TO GIFFORD PINCHOT.

FEASIBILITY OF ELECTROCHEMISTRY AT
THE DALLES.

BY O. F. STAFFORD.

FIRE PROTECTION OF ELECTRIC PLANTS.

BY M. E. CHENEY.

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29.
Sept. 7, 8, 12, 13.

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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy



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ELECTRIC ENTERPRISES IN JAPAN

The first electric undertaking in Japan was only directed towards the supply of electric lights in Tokyo, by the Tokyo Electric Light Company in November, 1887, with one home-made 75-lamp dynamo (afterwards replaced by two 220-lamp Edison dynamos) installed at Nihonbashi. In the following year the company constructed three more power stations, while the Kobe Electric Light Company, installed four 20 kilo-

Thereafter the electric business made a steady progress, and the first electric traction undertaking in Japan was the electric tramway which was opened in Kyoto in 1895.

The electric undertakings in Japan continued to increase their electric power, and at the same time the method of transmitting power to a long distance was into consideration. In 1899 an enterprise was



Vatsuzawa Plant of Tokyo Electric Company.

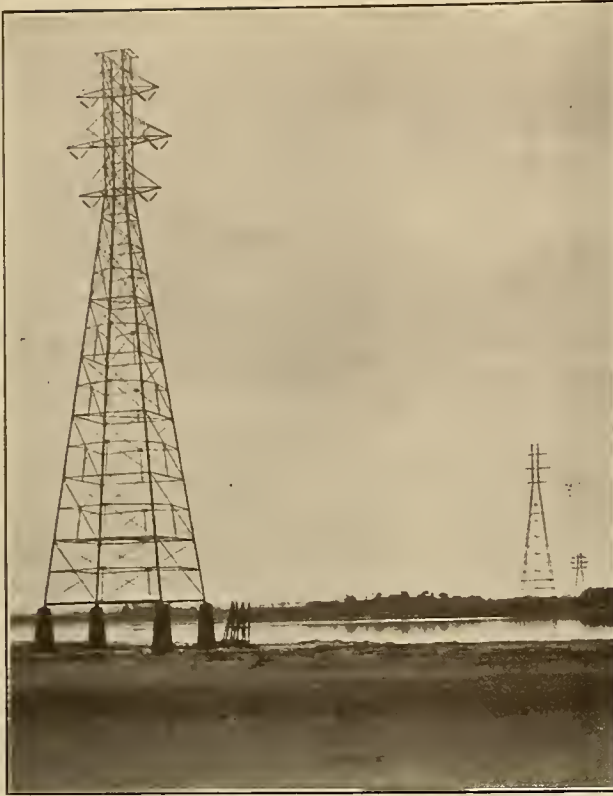
watt Edison dynamos and commenced the supply of lights in Kobe. The aggregate capacity of generating stations in Japan at the end of 1888 came to about 500 kilowatts.

In May 1889 the Osaka Light Company adopted the high tension alternating current system for the first time and opened its business in Osaka with one 30 kilowatt dynamo (1040 volts) of the Thomson-Houston type.

In the following year an electric light supply business was started in Kyoto, Nagoya and Yokohama, and thus the total capacity of generating stations reached 1500 kilowatts at the end of 1890.

opened in the town of Koriyama for the transmission of electric power over a distance of 15 miles at a pressure of 10,000 volts, the electric capacity concerned being 300 kilowatts. This undertaking having proved a success, the voltage was further enhanced and the distance of transmission extended.

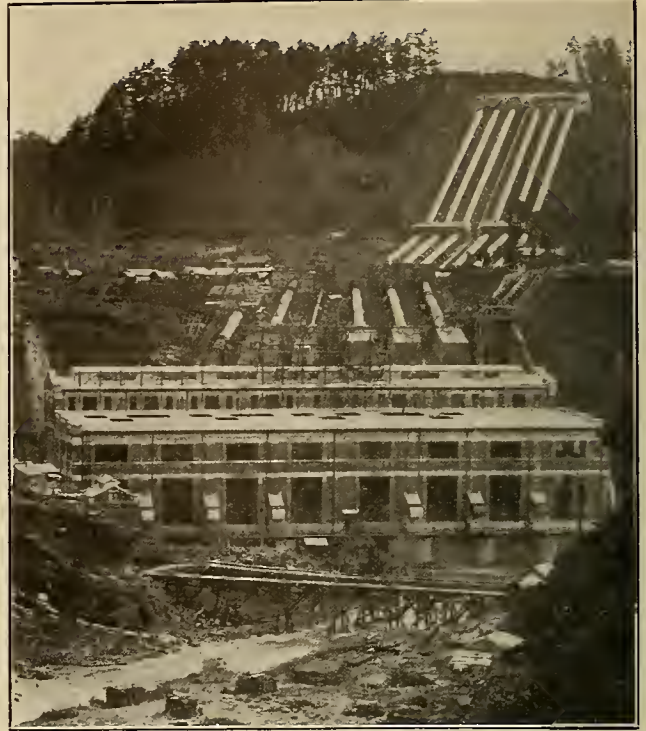
Towards the end of 1907 the Tokyo Electric Company established a hydroelectric power station at Komahashi, Yamanashi Prefecture, the capacity of which is 15,000 kilowatts, transmitting that power to Tokyo over a distance of 50 miles, to supply electric lights in Tokyo at 55,000 volts. In view of this successful undertaking of the Tokyo Electric Light Company similar undertakings have been contemplated at



Inawashiro 115,000 Volt Line, Showing 1530 ft. Span.

various places, availing themselves of the water power abundant in this country. Among those undertakings the enterprise of the Inawashiro Hydroelectric Company is the largest one ever established in Japan. In October, 1914, the company completed the work of the first hydroelectric generating station in the neighborhood of the Lake Inawashiro, the capacity of which is 14,000 kilowatts, transmitting the power to Tokyo over a distance of 140 miles at 115,000 volts.

In such circumstances electric undertakings in Japan are showing a rapidly progressive tendency; at the end of 1913 the total capacity of generating sta-



No. 1 Plant of Inawashiro Hydroelectric Company.

tions (exclusive of those under construction) amounted to 503,541 kilowatts; and the length of tracks of the electric traction reached 701 miles at the end of 1913, whereas it was only 72 miles at the end of 1903.

In 1910 the Hydraulic Power Investigation Bureau which was continued to 1913, was organized for the purpose of investigating hydraulic power to be utilized for generating electric power. The available hydraulic power in Japan estimated by the said bureau reached 2,205,224 horsepower.

At the end of 1914, for which period the Department of Communications has prepared the statistics which make up this article, there were 1609 electric undertakings in Japan, exclusive of Formosa, Corea,



Uji Plant of Ujigawa Hydroelectric Power Company.

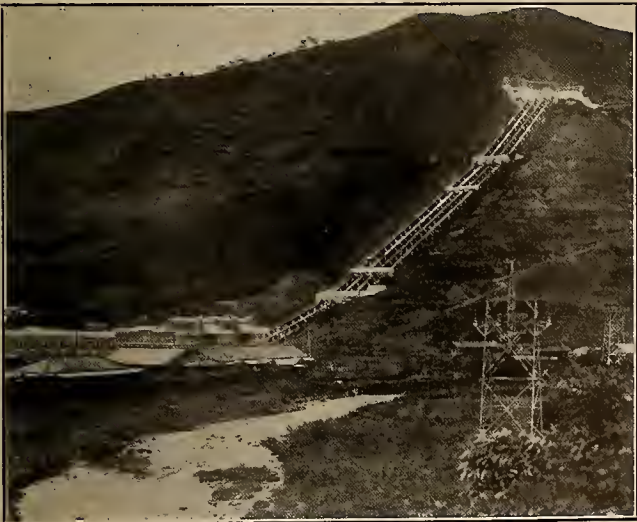
Saghalin and Kwantung. Of these, 1108 were isolated plants, 339 public utility supply, 19 electric traction and 97 official plants with a total capacity of 503,541 kw. These are segregated by kind of primary power as follows:

Undertakings.	Water.	Steam.	Gas.	Total.
Electric supply	213,847	53,124	6,965	273,936
Electric traction	180	3,300	.....	3,480
Electric traction & supply	28,525	59,425	434	88,384
Isolated plants	35,525	74,497	12,559	122,500
Official plants	400	14,571	270	15,241
Total	278,396	234,917	20,228	503,541

There are 247 hydroelectric plants, 130 steam plants and 117 gas engine plants, a total of 494 plants. Of 774 generators in these plants, 30 operate at 25 cycles, 226 at 50 cycles, 467 at 60 cycles, 9 at 100 cycles, 19 at 125 cycles and 23 others at various odd frequencies.

The length of transmission and number of supports is shown in the accompanying table:

Number of Electric Lines and Number of Supports.									
Undertakings.	Kinds.	Distance of lines. Miles.	Extension of Lines.				Number of Supports.		
			600 volts or less. Miles.	3500 volts or less. Miles.	Over 3500 volts. Miles.	Total. Miles.	Wooden pole.	Steel tower and steel pole.	Total.
Electric supply.....	Aerial line	11,596.0	12,863.4	23,707.3	7,662.0	44,232.7	425,346	5,036	430,382
	Underground line...	220.1	170.5	96.7	271.0	538.2			
	Total	11,816.1	13,033.9	23,804.0	7,933.0	44,770.9			
Electric traction.....	Aerial line	186.3	62.4	22.2	643.6	12,272	1,339	13,611
	Underground line ..	4.5	7.5	.....	.....	7.5	
	Total	190.8	628.9	22.2	.....	651.1		
Electric traction and supply.	Aerial line	4,333.3	7,038.5	8,444.1	2,674.9	18,157.5	174,406	12,314	186,720
	Underground line...	400.4	396.1	265.1	176.3	838.3			
	Total	4,733.7	7,434.6	8,710.0	2,851.2	18,995.8			
Grand total.....	Aerial line.....	16,115.6	20,523.3	32,173.6	10,336.9	63,033.8	612,024	18,689	630,713
	Underground line...	625.0	574.1	362.6	447.3	1,384.4			
	Total	16,740.6	21,097.4	32,536.2	10,784.2	64,417.8			



Shishidome Plant of Katsuragawa Electric Power Company.

The electric railway systems have 359 miles of single track and 463 miles of double track, a total of 822 miles. There are 3891 passenger cars and 396 freight cars.

There are 2,966,085 lighting consumers using 6,992,885 incandescent lamps, two-thirds of which are carbon filament. A flat rate is enjoyed by 2,903,280 of these consumers. There are also 32,033 motor users with 35,309 motors requiring 148,702 h p. and 219 consumers having 476 other appliances requiring 16,434 kw.

AN ANSWER TO GIFFORD PINCHOT.

Washington, D. C., May 1, 1916.

To the President:

Mr. Gifford Pinchot, former Chief Forester of the United States, addressed to you on January 29, 1916, a letter (which he immediately made public) urging you actively to oppose Senate Bill 3331, commonly known as the Shields Bill, relating to hydroelectric development in navigable streams. He wrote, as he declared, "in defense of the general interest" and on behalf of the National Conservation Association, a body of limited membership, not to be confused with the National Conservation Congress composed of delegates from all sections of the country which will meet in Washington tomorrow and presumably express its own views in some authoritative manner. In his letter Mr. Pinchot characterized the Shields Bill as a "threat against public warfare," as having the "great water power interests behind it," and as "astutely drawn" for such interests and in part by them.

Not content with having called your attention to these considerations, which if truthfully stated were of much gravity, he complained in a letter to newspaper editors a few days later that "feeble resistance or none at all is being made by official Washington."

Notwithstanding these characterizations and complaints, the Shields Bill, after having been reported favorably by a unanimous vote of the Committee on Interstate and Foreign Commerce, passed the Senate March 8, 1916, receiving the affirmative vote of 46 senators, against 22 in the negative. This was after a full month of open debate in which the opposition, under competent leadership, was accorded full and exhaustive hearing.

The undersigned, believing that the industry and prosperity of the country will be advanced thereby, respectfully urge you to throw the weight of your influence, in so far as you may deem proper, in favor of the passage of the Shields Bill, which is now in the House of Representatives, and beg to present their views, both as to the origin, meaning and effect of the Shields Bill and the justification or otherwise of the criticisms uttered by Mr. Pinchot.

The origin of the Shields Bill is in no respect doubtful. Amendment of the law relating to hydroelectric development in navigable streams has been the subject for many years of exhaustive study and consideration by committees of both houses of Congress. The National Waterways Commission five years ago made an elaborate report on the subject. The

judiciary committee of the Senate spent many months of research and study upon the legal questions involved. The House committee on interstate and foreign commerce conducted extended hearings on the subject. During each session of congress for nearly ten years, moreover, the subject has been debated, in various phases, by both houses. The result has been a thorough probing of every doubtful point. The passage of the Shields Bill by more than a two-thirds vote followed this long process and resulted from it. To charge that the Shields Bill, passed after the prolonged and open consideration above outlined, is the bill of any "interest" insults not only the Senate and Senators, but also public intelligence. The Shields Bill reflects the views of no one of the parties to this long and complex controversy. It is not even the bill of its introducer, nor of the committee which reported it. It was practically drafted by the Senate itself, in the light of long consideration and thorough knowledge. It is to be considered on its merits.

The distinguishing feature of the Shields Bill is that, unlike its predecessors, it presents a complete enactment under which hydroelectric development in navigable streams may go forward, subject to the direction and control of the government, whenever such development is physically and economically feasible. Under the present law an enabling act is required from Congress for each separate project. The Shields Bill fixes the fundamental requirements under which all such developments are to be permitted, leaving the issuance of the permit to the proper administrative department. By this means important resources hitherto locked up by the inaction of Congress are to be rendered available for the immediate and beneficial use of commerce and industry.

The bill fully safeguards every public interest developed and defined during ten years of public inquiry and discussion. No permit can be issued until the Secretary of War is satisfied, after examination, that the plans, specifications and location are such as are adapted to "a comprehensive plan for improvement of the waterway in question, for the uses of navigation, and for the full development of its water power and for other beneficial public purposes," thus insuring the uniform development of our streams so long contended for by disinterested students of our economic progress. The mere holding of permits without development and use, possibly to prevent competition, is effectively prevented by stringent requirements relating to the time for beginning and completing construction of the necessary works. The system provided by the bill for the regulation of rates, charges and service, a subject of prolonged controversy, fully recognizes the rights and duties of the states and the federal government and insures co-operation, not conflict. Compensation to the government in the form most useful to the public, namely, protecting and improving navigation, is provided in the sections of this bill dealing with locks and canals, and in the sections dealing with headwater reservoirs. The term of the permit is fixed at fifty years, and such permit must be relinquished by the holder at the end of that period if the United States, either for itself or for a subsequent permittee, determines to take over the property at its fair value, not including the value of the grant.

Uniform accounting and reports covering assets, liabilities, capitalizations, cost of construction, cost of operation, etc., are provided for, with severe penalties for false entry or misrepresentations. Persistent breach of the conditions of the permit is penalized by forfeiture, and adequate means are provided for enforcing all state and federal orders, regulations and requirements.

In view of the foregoing, it seems hardly necessary to examine in detail the criticisms of Mr. Pinchot, whose assertions are contradicted by the provisions of the bill. His specific charges against the measure will, however, be briefly dealt with.

Mr. Pinchot asserts that the Shields Bill—
"gives the use of enormously valuable public property to the water power interests without compensation."

If by this Mr. Pinchot means that no government tax for revenue purposes is imposed on the enterprise, he is correct. Such a tax would merely be a tax on the consumer of power, since it would be one of the elements necessarily involved in making the rates. Because this has been fully realized, the idea of raising government revenue from water power development has been abandoned by most of its early advocates. But it is wholly untrue that the Shields Bill gives the use of enormously valuable public property "without compensation."

Section 2 of the Bill, the section authorizing the permit, empowers the Secretary of War to require that the "grantee shall, to the extent necessary to preserve and improve navigation facilities at least equivalent to those existing prior to the construction of such dam, construct, in whole or in part, without expense to the United States, in connection with any such dam a lock or locks, booms, sluices, or other structures for navigation purposes, in accordance with plans, specifications, and conditions approved by the Secretary of War and made a part of such permit." A similar provision relating to a hydroelectric development already completed cost the holders of the permit approximately \$2,000,000 for a canal and lock constructed and transferred to the government. It might in some cases cost a great deal more.

The same section also provides that "in case such navigation facilities shall not be made a part of such original construction * * * then, whenever the United States shall deem such navigation facilities necessary the grantee shall convey to the United States, free of cost, such of its land and its right of way and such right of passage through its dams or other structures, and permit such control of pools as may be required for such navigation facilities, and shall furnish free of cost power for the operation of the same" and also that "such grantee shall pay to the United States reasonable charges in consideration of the benefits accruing to and used by such grantee through the construction, operation, and maintenance by the United States of headwater improvements, including storage reservoirs."

Mr. Pinchot also asserts that the Shields Bill—
"has been so drawn as to make it practically impossible for the people to take their own water powers back into their hands."

Section 6 of the Bill contains a clear, practicable

and effective plan for "recapture" after fifty years, the term of the permit. Under this section the United States may terminate the rights of the grantee after fifty years upon the taking over by the United States of all the property of the grantee which constitutes part of the plant and is dependent, in whole or in part, upon it for its usefulness and so acquired, or is necessary, appurtenant, valuable or serviceable in the the distribution of water or in the generation, transmission and distribution of power, and upon paying to the grantee the fair value of the property taken and assuming contracts previously made under government sanction. By a further provision of this section, the United States is permitted not only to terminate the permit and take over the property for its own use, but also for the use of a subsequent permittee.

Mr. Pinchot also asserts that the Shields Bill—"interposes every possible legal delay between the violation of a government permit and the chance of effective enforcement."

Section 8 of the Bill imposes a fine of \$1000 for every violation by a permittee of the provisions of the act, or of any of the conditions of the permit or of any lawful regulations or orders of the Secretary of War; confers special jurisdiction upon the United States District Courts summarily to enforce such provisions, conditions, regulations, and orders; and in case of persistent violation, authority is given for a decree revoking all rights and privileges granted under authority of the act.

Mr. Pinchot also asserts that the Shields Bill—"fails to require the necessary publicity and uniformity of accounts, and so makes the effective supervision of water power corporations impossible."

Section 7 of the Bill makes provision for exactly what Mr. Pinchot asserts is lacking, in the following language:

"The Secretary of War shall have the right to provide rules and regulations for uniform accounting, to examine all books and accounts of grantees under the terms of this Act, to require them to submit statements, representations or reports, annual or special, including full information as to assets and liabilities, capitalization, cost of project, cost of operation, the production, use, transmission and sale of power. All such statements, representations, and reports shall be upon oath unless otherwise specified, and in such form and on such blanks as the Secretaries may require, and any person making any false entry, statement, representation or report under oath shall be subject to punishment as for perjury."

Mr. Pinchot also asserts that the Shields Bill—"gives to the water power interests the right to condemn or take any land they choose."

This charge is contradicted by the provisions of subdivision two of Section 2 of this bill, requiring that the Secretary of War be first satisfied regarding the qualifications of the grantee and the appropriateness of the project before construction is begun.

Mr. Pinchot also asserts that the Shields Bill—"forces the people, when they take back the public property whose use they have granted, to pay the unearned increment on land condemned or otherwise acquired by the grantee."

What the people "take back" upon recapture is something very different from "the public property whose use they have granted." It is the latter, together with all the plant that has been built up out of fifty years' investment of private investors,

For "the public property whose use they have granted," the people pay absolutely nothing upon recapture. In the words of the Bill: "no value shall be claimed by or allowed to the grantee for the rights hereunder granted."

But for the property acquired and built up out of the investors' own money, the United States, when it takes it over, must pay to the grantee "the fair value." To call the value accruing to this property after fifty years' investment an "unearned increment" is to stigmatize this form of investment with a term that is absolutely a misnomer. With "the rights hereunder granted" forever eliminated from the value of the property, there remains no "unearned increment" whatsoever. If what is left be indeed in any part "unearned increment," then all real estate investment, of every kind whatsoever, includes "unearned increment."

When the government determines that every real estate owner must relinquish to the federal government any increase in value that accrues upon his property through his foresight, skill and energy with which he develops his investment, the government may, in the computation of "fair value" upon recapture of water power developments, fairly exclude every item of appreciation in land value. But until the government adopts this policy toward every kind of real estate owner, it would be grossly unfair and utterly discouraging to water power development to enforce this rule against investors in such developments, while it enforces no such rule against investors in other forms of real estate, even though such real estate be actually adjoining water power developments and appreciate in value solely because of such proximity.

If the United States takes over any water power development, it necessarily takes it over as it stands, as an entirety. Common honesty can, therefore, suggest no other basis of compensation than "paying to the grantee the fair value of said property," which is precisely what the Shields Bill, as passed by the Senate, provides.

This is all that is meant by paying "fair value" upon recapture.

Without unfairness to Mr. Pinchot, it is submitted that the above presentation of facts shows his assertions with reference to the Shields Bill to be incorrect and misleading.

Yours very truly,

H. W. HAND,
CALVERT TOWNLEY,
W. W. NICOLS,
CHESTER W. LARNER,
J. E. WAY,

Executive Committee Water Power Development Association.

Hon. Woodrow Wilson, President of the United States.

Trouble with CO₂ recorders usually is due to the fact that persons responsible for their operation are not thoroughly and properly instructed. Bulletin 91 of the U. S. Bureau of Mines describes tests on various makes of instruments and gives valuable suggestions in their use in furthering power plant economy.

FEASIBILITY OF ELECTROCHEMISTRY AT THE DALLES.

BY O. F. STAFFORD.

(Continued.)

Phosphate rock. This material is utilized upon an enormous scale as a constituent of commercial fertilizer. The usual method of preparing phosphate fertilizer is to grind the naturally occurring phosphate rock to a powder and treat it with sulfuric acid, whereby the phosphate content becomes more soluble and more immediately available for the use of plants. The magnitude of the phosphate industry in the United States is indicated by the fact that in 1913 over 3,000,000 tons were produced, three-fifths of which was consumed at home.

The phosphate rock industry has had its greatest development in the southeastern states of Florida, Tennessee, South Carolina, Kentucky and Arkansas. Recently, however, extensive fields of phosphate rock have been discovered in Utah, Idaho, Wyoming and Montana, it being estimated that 85 per cent of the reserve supply of phosphate rock in the United States exists in these western states.

Attempts have been made from time to time to utilize the heat of the electric furnace for the treatment of phosphate rock rather than to use the sulfuric acid which has always been made use of for this purpose. These attempts may be said to be still largely in the experimental stage, although if rumors seemingly coming from dependable sources are to be at all credited the plan to make use of the electric furnace may be looked forward to with confidence as a coming process.

Assuming that this prediction may in time be substantiated, western water powers must play an important part in the process of making the enormous stores of phosphate rock in the West available for agriculture. The rock itself is to be regarded as a heavy chemical and therefore cannot be transported long distances for treatment, so that the logical solution of the problem of phosphatic fertilizer supply in case electric furnace methods do materialize is to make use of the western water powers and carry the finished product to the market centers.

What may be at present regarded as the center of the western phosphate field lies in southeastern Idaho near the towns of Soda Springs, Georgetown and Montpelier, on the Oregon Short Line Railroad. The rock is mined by processes similar to the mining of coal where the seams are worked by means of quarries, tunnels and shafts. The average cost of mining is said to be \$1.50 per ton. Haulage to the railroad by wagons varies from 50 cents to 75 cents a ton while freight from shipping point to The Dalles may be taken as \$4 a ton, the distance being in round figures 800 miles. It follows, therefore, that the price of phosphate rock at the electric furnace site would be not less than \$6.50 per ton, allowing the producer of the rock a profit at 50 cents.

The Electrochemical Industries.

Under this heading will be considered the industries producing the following substances: abrasives, caustic and bleach, calcium carbide, chlorates, cyanides, graphite, phosphorous compounds, nitrogen compounds.

Abrasives.

Until the advent of cheap electricity the world's supply of abrasives was practically altogether from natural sources. Certain sandstones, chosen according to the sharpness or the fineness of their sand particles, furnished a variety of grindstones and hones which were made to answer for many purposes, while emery, when crushed and sized, could be used as powder or be formed into wheels or hones useful where the needs were more exacting than would be satisfied by grindstones.

In 1891 the discovery was made that a mixture of coke and sand, when suitably heated in the electric furnace, would yield a crystalline compound of carbon and silicon which at first was thought to rival even the diamond in hardness. Later tests demonstrated that although the diamond might still retain its supremacy as the hardest of all substances nevertheless the new material was an abrasive of exceptional value. It is now manufactured both under its original trade name, carborundum, and under another trade, name, crystolon.

Raw materials are reported to be coke or anthracite, sand, sawdust and salt. It is estimated that these cost at Niagara Falls approximately \$6 per ton of finished product and require for their conversion into abrasive about one and one-fifth horse-power-years of electrical energy. Other costs are not available, but assuming the cost at the furnace to be \$30 per ton at the present factories and taking into account the higher cost of materials, labor and capital in the West, even though power in the East is figured at \$15 per horse-power-year and in the West at \$9, the advantage is with the eastern location to the extent of approximately \$5 per ton.

Another abrasive has lately come into the market which is made in the electric furnace from bauxite, the crude ore of aluminum. This substance, called alundum, is fused aluminum oxide and accordingly akin chemically to natural emery, to which, however, it is much superior as an abrasive. It was estimated that in 1913 aluminum ore corresponding to 10,000 tons of metallic aluminum would be converted into alundum. Cost data regarding the manufacture of this abrasive are not available, but since the raw material necessary is more easily obtained at eastern manufacturing points than at western it is certain that a cost comparison would be unfavorable to a western location.

A peculiar market situation exists with reference to these abrasives in that they are really the raw materials for another industry, the making of wheels, hones, etc. This industry is naturally under the control of the firms producing the raw abrasives. When it is considered that much additional labor is expended in making and marketing these finished products the power costs, reckoned against the final selling prices, become relatively unimportant, a fact which further operates against the proposal to remove the industry to a point where only cheaper power may be available.

Also it is probable that 98 per cent of all abrasives made are consumed in the metal-working industries of the northeastern states, a consideration which makes the present locations of the abrasives-producing industry commandingly ideal.

It is therefore certain that an electro-chemical abrasives industry in the West would exist under a handicap both as regards production costs and transportation which would render competition with factories at an eastern site extremely difficult if not absolutely impossible.

Caustic and Bleach.

By the term "caustic" in the present case is meant the common commercial form of concentrated lye known also in the chemical trade as sodium hydroxide. This substance is in use in a large way in the arts and its manufacture represents one of the largest of the chemical industries. Its raw material is common salt. Formerly the production of lye was accomplished altogether through the intermediate manufacture of sodium carbonate, common forms of which are familiar as soda ash and sal soda. Sodium carbonate upon treatment with lime yields lye. This method is still in use and furnishes a large part of the total world's production.

With the possibility of cheap electricity an electrolytic method for the production of lye from salt directly was quickly perfected, the lye formation being simultaneously accompanied by the formation of chlorine gas, a substance which combines readily with quick lime to form bleaching powder. It is therefore obvious that the electrolytic alkali industry is inseparably connected with the "bleach" industry. The relative amounts of the two substances vary with the processes used and with other conditions, but may be taken in round numbers as five parts of lye produced for every 12 parts of bleaching powder.

The manufacture of lye alone by the electrolytic process would not be possible in competition with the lye produced by the older soda process were it not for the revenue obtained from the sale of the bleaching powder. In a sense, therefore, bleaching powder is the primary product in this industry, since the amount of this substance which can be marketed really determines the amount of lye which may be produced.

Both caustic and bleaching powder are to be considered as heavy chemicals since they are normally valued at approximately \$45 and \$30 per short ton respectively at factory site. They are therefore not to be manufactured at long distances from their markets. It is usually considered that the market for lye is distributed in a manner roughly proportional to the distribution of population. The consumption of bleaching powder, however, is more localized, its main use being in connection with the textile industries.

The production of electrolytic lye in the United States in 1909 is given as 22,000 tons valued at \$47 per ton. The corresponding production of bleaching powder was 50,000 long tons valued at \$29.50 per ton. Electrical power consumed in the industry was approximately 12,500 horsepower-years. The production of lye by the soda process in the same year is given as 125,000 tons, making about 15 per cent of the total as the production of the electrolytic plants.

All costs of producing electrolytic lye would be higher at a western plant than at an eastern, excepting the cost of power. Capital and labor costs may be taken as 15 per cent higher; lime will cost \$6 in

the West as against \$4.50 in the East; salt will cost \$6 at The Dalles as compared with \$2.50 at an eastern power site; coal will cost \$5 a ton as compared with \$3; while power may be taken at \$9 instead of \$18 per horsepower-year.

Assuming a plant capable of making 4000 tons of lye and 10,000 tons of bleach per annum and having a capitalization of \$300,000, the cost of producing one ton of lye and the corresponding $2\frac{1}{2}$ tons of bleaching powder may be taken as \$75 at the eastern point as compared with \$90 at the western. The apportionment of costs against the lye and bleach respectively is obviously a matter of bookkeeping only. With lye selling at \$45 and bleach at \$25 per ton the income from the quantities just considered would be \$107.50.

From the above analysis it follows that western made electrolytic lye and bleach can never enter the eastern market until the cost of power in the East shall advance to a point where not only the above difference in production costs is equalized, but to where the cost of transportation to the East shall be compensated as well. Assuming that freight from The Dalles to New York may sometime be such that the $3\frac{1}{2}$ tons in question may be moved this distance for \$15, there would then be a difference of \$30 altogether for the western manufacturer to overcome by virtue of his cheaper power costs. Fixing western power at a cost of \$9 per horsepower-year, and considering that one-half horsepower-year only will be consumed for the one ton of caustic and its corresponding $2\frac{1}{2}$ tons of bleach, this amount of power would have to cost \$30 more at the eastern factory than at the western site. In other words until the cost of power in the East, in round figures, should approach \$70 per horsepower-year, the cheaper western power would not offset the general disadvantages of the western location as far as serving eastern markets might be concerned. It is needless to point out that power will not have any such value in the East for a long time to come, steam power itself being available at a much lower figure.

On the other hand, the manufacture of caustic and bleach up to the limit of construction by Pacific Coast markets should be altogether a possibility at some favorable western power site. It is estimated that the coast consumption of lye is approximately 4000 tons, or just about the amount considered in the manufacturing unit assumed above. Japan is said to have used 5000 tons of English lye in 1911 while doubtless other markets might be found which could be served more easily from the western coast than from the eastern. The disposition of the corresponding 10,000 tons of bleach is a much more doubtful matter, however, since the consumption in the Pacific Coast states is estimated to be but 5000 tons.

It would seem, therefore, that under present conditions the manufacture of electrolytic lye and bleach could not be carried along profitably upon the western coast were the output greater than approximately 2000 tons of lye and 5000 tons of bleaching powder. Such a unit would absorb practically but 1000 horsepower-years of energy.

(To be continued.)

FIRE PROTECTION OF ELECTRIC PLANTS.

BY M. E. CHENEY.

(After detailing the fire hazards of electric plants and the means of correction, specifications are given for a standard plant construction to minimize the insurance rate. Subsequent installments analyse a typical steam plant and show how its departure from standard construction affects the rates. This article is slightly abridged from a paper presented at a joint meeting of the A. I. E. E. and N. E. L. A. Sections at Portland April 11, 1916. The author is electrical engineer with the Washington Surveying and Rating Bureau of Seattle, which has jurisdiction in Washington only. Methods outlined and rules and charges for deficiencies apply only to such jurisdiction.—The Editor.)

Experience indicates that the commonest cause of extended interruption to power and light service and delay to electric car traffic, particularly in cities, is due to destruction of power plants or rolling stock by fire. The numerous recent fires in electric properties in the United States, is demanding the attention of electrical and insurance interests, and of the public in general. Not long ago in one of the electrical journals were listed no less than four power plants completely destroyed by fire.

A study of the statistics of 95 power plant fires compiled by the National Fire Protection Association reveals the surprising fact that fires resulting from the common causes outnumber those from the special hazards two to one. Of the boiler fires, which are responsible for over 25 per cent of the losses from all causes, one-third originated because of the iron stack improperly installed. Of the special hazard fires, electric wiring, either defective or by reason of crossed circuits, was productive of the greatest trouble. The preponderance of fires from common causes over those from special hazards, while indicating that the present practice of safeguarding the electrical hazards is effective, strikingly brings out the disregard of properly safeguarding the common hazards, such as heating, lighting, boiler settings, care of oily waste, and general accumulations of combustible material not necessary to the operation of the plant.

The records show that only two fires occurred in plants of fire-resistive construction. A little over one-third of the buildings were brick and wood construction.

An important fact, and one which is undoubtedly responsible for the extent of the losses, was the absence of private external or internal protection in practically all of the plants. Nearly one-half of the fires were extinguished by the help of public departments. Extinguishers where used were always reported as being satisfactory.

Several interesting features regarding the losses are brought out from the reports. Losses to buildings were either total or slight, while the losses on contents were usually heavy. These results would have been greatly modified by the existence of fire walls separating the station into individual areas, which would under normal conditions be more or less immune from fire in any other section.

Just how many of the 95 fires were preventable with ordinary care or could have been readily extinguished in their incipency, had adequate means of protection been installed can only be estimated, but

careful study of their history leads one to believe that it is well above 60 per cent. These 95 fires demonstrate beyond a doubt that:

Roof coverings having good fire retardant qualities are essential to the safety of the power house.

That power houses having roofs of combustible material are always liable to serious damage, especially where remote from fire protection.

That ventilators or other roof structures of frame construction are a menace even on unexposed stations.

That power air ducts or chambers for cooling transformers, and similar construction work forming concealed spaces which may hide the presence of fire are an unnecessary fire danger.

That combustible supplies, especially waste—clean or oily—should be kept in covered enclosures of non-combustible material.

That switchboards should be so located and guarded that not only may operators manipulate control apparatus in safety but that such apparatus and boards will be susceptible to damage from disorders on the wheel or generator floor.

That quick acting valves controlling turbines should be so located in hydroelectric plants that water may be promptly cut off from points outside the zones of possible trouble.

That greater care must be exercised in the choice of capacities and types of oil switches.

That apparatus performing different functions should be segregated, that is, the switching, generating and controlling apparatus should be separated from each other.

That sand pails and extinguishers prove very effective in extinguishing fires in their incipency.

That standpipe and hose equipment with ample water supply and pressure sufficient to produce effective fire streams are indispensable to the station with combustible roofs or floors or those containing quantities of combustible material. Particularly is this true of stations remote from public protection.

That oil transformers under normal conditions and when properly operated are not a serious fire hazard. The chief hazard lies in a severe arc near the surface of the oil or from oil escaping from the transformer case; and a serious hazard lies in drying out transformers by charcoal fires under them—particularly so when leaks develop in the case.

In fact, so many destructive fires have occurred from preventable causes both in power plants and electric traction properties that comparatively large concessions are made in insurance rates for the correction of these so-called remedial defects in building and equipment. A number of electric companies in Washington, through making improvements in their property whereby the fire hazard is reduced, aside from attaining immunity from interrupted service through fire to a marked degree, have had returned to them from ten to twenty per cent per annum on the money throughout the state, from which improvements vast benefits in a reduced fire waste would be reaped.

Insomuch as one of the functions of the Washington Surveying and Rating Bureau is to obtain a reduction in the fire waste as well as to recommend equitable insurance rates, it is in these capacities anx-

ious to co-operate with you for the mutual benefit of yourselves and the insurance companies.

To more clearly demonstrate to you the concessions made in insurance rates on power plants for standard construction and protection, and to show the methods employed in estimating a rate on such a plant, I will first run over briefly the essentials of a so-called standard plant and then rate for you a typical plant which we will construct for the purpose, pointing out the various chargeable deficiencies and showing the reduction in rate effected by correcting the remedial defects.

The Standard Plant.

In considering the ideal construction and arrangement of a power plant to reduce to a minimum possible property loss or interruption to service by fire there is one feature which stands out paramount, this is, the type of structure housing the apparatus. This should be of highest possible type of fire-proofed construction, incorporating in brief the following details:

Walls.—To be of hard-burned brick, stone or reinforced concrete, not less than 12 in. in thickness for buildings not over one-story in height, and increasing proportionately for buildings over that height. In a word, walls to be strictly in conformity with the National Board of Fire Underwriters' requirements, as given in their building code. All cut-off or division walls segregating sections of the plant to be of similar construction as the outside walls and have all openings protected by double standard automatic fire doors.

Partitions.—All to be of non-combustible material.

Roof to be constructed of non-combustible material, and have non-combustible covering or approval composition.

Roof trusses.—All metal to be insulated on the sides by not less than four inches and on the top and bottom by not less than two inches of concrete, terra cotta or other approved insulating material recommended by the Building Code of the National Board of Fire Underwriters.

Skylights.—To be of approved wired-glass in metal frames.

Floors.—Concrete, cement, iron or brick.

Stairs.—To be non-combustible.

Finish.—To have no concealed spaces.

Exterior attachments.—Building to be free from combustible cornices, porches or other exterior attachments.

Lighting.—By electricity. Wires to be installed in approved conduit in conformity with National Electrical Code.

Heat.—Steam, electric, hot water or hot air. Pipes to be free from wood work and supported on iron hangers. Electric wiring for heaters to be in conduit in conformity with the requirements of the National Electrical Code. Air ducts through division or cut-off walls or floors to be fitted with a self-releasing damper so installed as to prevent the spreading of fire through the ducts from one section of floor to another.

Fuel oil system.—To be constructed and installed in conformity with specifications of the National Board of Fire Underwriters.

Occupancy.—Generating, substation, transformer station and/or storage battery station only.

Conductors.—(a) Lead encased cable installed in metal or other approved ducts.

(b) To be properly protected by flameproof covering where grouped as behind switchboards and control panels.

(c) To be properly protected by automatic overload devices.

Switchboard.—To be of slate or marble readily accessible from all sides and so located that the attendant will have at all times a full view of moving apparatus under his control. Switching apparatus for currents in excess of 6600 volts to be operated through remote control switches. All oil switches, whether automatic or non-automatic, controlling current at a difference of potential in excess of 6600 volts to be enclosed in fireproof compartments unless such switches be of the boiler tank type.

Resistances and rheostats.—To be of an approved type, standardly installed in a location free from combustible material.

Lightning arresters.—All overhead leads entering station to be protected. Electrolytic arresters preferred. These to be located either outside the station or in a separate enclosure, cut off from the remainder of the building. All choke coils or other attachments inherent to the lightning protective equipment to have an insulation from ground or other conductors equivalent at least to the insulation specified at other points of the circuit in the station.

Transformers.—Oil transformers to be located in a fireproofed room or compartment, provided for the purpose, cut off from the remainder of the building, properly equipped with drain and ventilation. Transformers should be equipped with a quick opening valve so that oil may be drained rapidly from the case should necessity for so doing arise. The door sill to the compartment should be raised at least six inches above the floor level to insure the non-escape of oil into other sections of the building.

Air-cooled transformers.—Should be insulated as far as possible from other apparatus and supplied with air through a fire-proof duct.

Waste Cans.—Standard metal waste cans to be provided and all waste, clean or oily, kept therein.

Clothes lockers.—To be of metal of an approved type.

Oils.—Not exceeding three barrels of lubricating oils may be kept in standard cabinets or central oiling system may be used; otherwise only one day's supply should be kept in building. No kerosene, gasoline or other volatile combustible liquids to be kept on the premises.

Watchman.—If not running night and day continuously there should be an approved watch-clock and hourly records made thereon, all dials to be kept on file for inspection, provided that in areas of not over 8500 sq. ft. watchman will not be required.

Fire protection—Internal.—It has been aptly stated that all fires are of the same size when they start and that a little fire is quickly trodden out, yet, being suffered, rivers cannot quench. Ample means

for extinguishing the small blaze is a prerequisite, even in a standard plant with little combustible material. For this purpose are recommended pails of dry sand and chemical extinguishers. A rule often followed for the distribution of sand pails and extinguishers is three of the former and one of the latter to each 4000 sq. ft. of floor area. In our standard station, owing to the small amount of combustible material present, carbon tetrachloride extinguishers, such as the J. M., Justrite and Pyrene, all of which are approved by the Underwriters' Laboratories, are recommended. Owing also to the small amount of combustible material present and the type of construction of our standard station other protection of either a private or public character is not deemed a necessity.

Exposures.—However well our station is constructed, however well all openings in our walls are protected, with wired glass in metal frames or with shutters, care should be exercised to prevent the erection of frame, or other combustible buildings, within a radius of at least 20 ft. With such a standard plant, standardly maintained, little anxiety need to be felt as to interruption of service because of fire within the plant. In fact, such plants have even withstood the ravages of conflagrations which spread through and destroyed other structures. A recent notable example of this is the Salem Gas & Electric Company's generating station, which passed without serious damage through the great Salem conflagration.

Insurance Rating.

While the standard plant is the ideal and the end to be desired, unfortunately few of these plants exist, the greater number being of vastly inferior construction, many wholly or in part of frame or corrugated iron on wood supports or other equally combustible material.

The rate-maker must, however, be equipped to place an adequate and just rate on any type of building or installation under any or all conditions or combination of conditions that may obtain and he has as a key for estimating the fire hazards of such stations a schedule which names not only a basic rate or starting point for a particular type of station but also the charges to be added to the basis for the various deviations from the standards of construction and installation. Schedules are arranged by committees of experts and over a number of years are a reflection of the experience of insurance companies on the particular class of risk to which the schedule applies.

Along with the rate-maker comes the protection engineer, who, after an exhaustive survey of a particular plant, makes recommendations for relieving the fire hazard in the plant. Compliance with his recommendations immediately is reflected in the insurance rate on such property.

The one inflexible law of rate-making is "The premium income must be commensurate with the hazard." Hence it naturally follows that a reduction of the hazard justifies a reduction in the premium rate. The operation of the schedule and routine followed by the rate-maker as well as by the protection engineer is best shown by an application of the schedule to the following typical steam plant.

[To be continued.]

LETTERS TO THE EDITOR.

A Foredoomed Experiment.

Sir:—My attention has been drawn to an editorial entitled "A Foredoomed Experiment," appearing in your issue of May 13, 1916, and referring to the recent decisions of the railroad commission in the San Joaquin Light & Power Corporation and Mt. Whitney Power & Electric Company cases.

This editorial is incorrect in its statements of fact in a number of important respects and unless corrected may do serious injury to these utilities in their future financing as well as work an injustice to the railroad commission. I am certain that you would not intentionally misstate the facts and accordingly ask, in justice both to these utilities and to the railroad commission, that you publish this letter in your next issue.

You are, I assume, aware that the railroad commission, acting in accordance with a formal request from each of these utilities, established **all** the rates, rules, regulations and contracts to be henceforth charged and observed by them in connection with **each** class of service rendered by them.

As your statements are limited to those portions of the railroad commission's decisions which refer to the agricultural power business of these utilities, I shall confine myself to this class of business.

Preliminarily, I desire to call attention to the fact that the entire agricultural power business of the San Joaquin Light & Power Corporation, in terms of connected load, is but 14.1 per cent of the total load served by this utility. Of this 14.1 per cent not more than 52.5 per cent was supplied during 1915 at the \$50 per horsepower per year rate. The agricultural power business of the Mt. Whitney Power & Electric Company in 1915, after it had acquired the properties and business of the Tulare County Power Company, was approximately 56.25 per cent of its entire connected load and only about 48 per cent of this agricultural business was supplied under the annual rate of \$50 per horsepower per year.

1. The statement in your editorial that "both the San Joaquin Light & Power Corporation and the Mt. Whitney had been serving irrigation consumers at a flat rate of \$50 per horsepower per year," may be misleading in that it does not draw attention to the fact that each of these companies had other flat and meter rates for agricultural power, considerably lower than the annual rate of \$50 per horsepower per year.

2. The statement that "in each case the commission has not only reduced this rate to \$42.30, but has given an alternative monthly graded rate whereby a farmer may have seven months' service for \$29.75" is inaccurate. The \$50 rate was on the basis of maximum demand while the \$42.30 rate is on the basis of connected load. Speaking in each case in terms of connected load, the reduction was from \$47 to \$42.30 in the annual rate, and from \$37.84 to \$29.75 for the seven months' rate.

3. The statement that "as seven months is the average period for irrigation pumping in the San Joaquin Valley, the new rate represents a reduction of

virtually forty per cent in the income per horsepower of installed capacity from such irrigation consumers," is misleading both because the average period for irrigation pumping in the San Joaquin Valley is in excess of seven months and because each of these utilities already handled a considerable portion of their agricultural pumping business under seasonal rates considerably cheaper than the twelve months' rate of \$50 per horsepower.

4. The statement that "coupled with this tremendous reduction in rate, the consumer may secure service without signing a contract or without giving any guarantee that bills will be paid, such as was formerly secured by a lien on the land," is contrary to the facts in three particulars. First—no tremendous reduction has been made in the rates; second—contracts are expressly permitted in the first instance for agricultural power business under the commission's decision; and third—ample protection is accorded the utility by means of advance payments, deposits and guarantees. While the lien clause, which in effect made every contract a mortgage on the consumer's lands, has been eliminated, it may be proper to draw attention to the fact that this clause has long since been voluntarily abandoned by practically every other electrical utility in California.

5. The criticism regarding rights of way is apparently based upon a misconception of the facts. I do not believe that the Journal would champion any system which denied service to a consumer unless he donated a perpetual right of way over his lands to the serving utility, not only to the point where the service is to be used but also to any and all points beyond.

While the railroad commission has completely revised the rules, regulations and contracts of each of these utilities, it is only justice to these utilities to say that their officials frankly admitted that these rules, regulations and contracts were largely a survival from conditions which have now passed, and that the revisions made by the railroad commission are fair and just.

Your editorial did not draw attention to the very large amount of gas engine agricultural pumping business located within the territory served by these utilities, which business the utilities were unable to secure because of their higher rates but of which a large portion will now be secured by them. The evidence showed that 22,000 horsepower of this business is located within one mile of the distributing lines of one of these utilities.

I am prompted particularly in writing this letter by the fact that unguarded and unfounded statements concerning "tremendous reductions in rates" must inevitably, unless corrected, act injuriously on the utilities affected in their future financing. These two utilities are doing a very necessary and praiseworthy service to the communities which they serve, and neither the railroad commission nor any one else who wants to see this state continue to develop and to see public utilities fairly treated, desires to inflict any unjust or unnecessary injury to them.

You will be interested to know that each of these utilities has filed the rates, rules, regulations and con-

tracts prescribed by the railroad commission. The president and the treasurer of the utility most affected by the decisions have written to the commission expressing their appreciation of the commission's fairness during the hearings and in the decision—an unusual and much appreciated tribute—and stating their confidence in the result of the rates established. Both utilities are proceeding in good faith, under the rates established by the commission. The commission is satisfied that each of these utilities will find itself in a stronger position than under the old rates, which kept off a large amount of desirable business.

Thanking you in advance for the courtesy of publishing this letter, I remain

Yours truly,

MAX THELEN, President.

San Francisco, May 16, 1916.

[Mr. Thelen's authoritative interpretation of the commission's purpose in rendering this decision is seen to be entirely at variance with our own estimate of its probable effect. As time alone can give the answer, the subject cannot profitably be one for present decisive discussion. With due defensive deference, however, the only statement which Mr. Thelen cites as being "contrary to the facts," upon investigation, will be found true. The farmers in the San Joaquin Valley are jubilant over "the tremendous reduction in rate, the consumer may secure service without signing a contract," and experience has proven that the guarantees provided are inadequate to protect against dishonesty. Furthermore, difficulties in financing are due not so much to comment regarding decisions as to the apparent tenor of the decisions themselves.—The Editor.]

SALES VALUE OF ILLUMINATION.

At a recent meeting of the Louisville Gas & Electric Company, Emile Pilpel spoke on the sales value of good illumination. As an illustration he described approaching an old lady who ran a little shop on one of the streets out of the line of traffic where eggs and butter were sold. The shop was illuminated very dimly with carbon lamps. He spent some time trying to persuade the old lady to substitute large nitrogen lamps to replace the small carbon units, but was unable to convince her that the increased illumination would have sufficient sales value to justify the expenditure. Therefore he got her permission to try a little experiment. He placed one case of eggs on the sidewalk at one side of the entrance over which he hung a carbon lamp and put a sign over the eggs reading "Fresh Eggs—25c per Dozen." On the side of the doorway he placed another case of the same eggs over which he hung a bright nitrogen lamp and a sign reading "Fresh Laid Eggs—27c per Dozen." Then he stood in the background and watched the proceedings, and every one who came near walked over to the bright light and bought the eggs labeled "Fresh Laid Eggs" and paying for them at the rate of 27c per dozen. During the evening the old lady sold out that entire stock and none had been sold out of the other one. By this demonstration he convinced his customer of the sales value of illumination.

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A famous engineer visiting a great industrial plant, when asked what he particularly wished to see, replied "Your scrap pile." And in that waste heap he found so much of interest that he never went near the plant itself. He read the record of the plant in the quality of the material discarded.

Profit from the Junk Pile

Today many a scrap pile is being made a source of profit as well as of instruction because of the abnormally high prices of metals. In the course of wrecking the Panama-Pacific International Exposition, now well-nigh completed, the electrical department is disposing of much second-hand material at higher prices than were originally paid. In fact, regret has been expressed that copper conductors had been originally figured so closely, as the metal is today worth more than twice what was paid for it. A number of electric companies have also found it profitable to scrap aluminum transmission lines, substituting copper and even to replace copper distribution lines with iron wire, because of the high price the rarer metals command.

Another important result to be attained in keeping a close tab on the scrap pile is the checking of possible waste. One Western plant, which recently found it impossible to get better than six months' delivery on certain supplies, upon chance investigation of the scrap pile, found a quantity of material, which with slight modification was adapted to the required use and thus bridged what threatened to be a serious suspension of operations. As a consequence of this opportune discovery a careful inventory was made and a number of possible shortages forestalled. Hereafter, in this plant, accurate record is to be kept of everything consigned to the scrap heap.

Just as yesterday's progress depended upon the conversion of waste products into profitable by-products, so does today's depend upon intelligent utilization of the scrap pile.

Furthermore, it is a mistake to imagine that the only valuable junk is that which can be seen and touched. The caliber of an establishment can be judged as much by its discarded mental junk as by its physical scrap pile. The true measure of many a concern can be determined from the wornout ideas which have been abandoned.

In this respect a dump pile is valuable not so much from what can be salvaged as from what can be learned. There is usually some good reason for consigning anything to the limbo. Analyses usually shows that the reason is still subject to present justification.

Among the mental conceptions which scientific management tossed into the junk heap was the notion that the greater volume of output is to be gained by driving men and machines at top-notch speed. This idea is still obsolescent and in its place is found the rational thought that the real way to make speed is not to waste time.

Again, the reduction in rates for electric lighting has been due not so much to increased efficiency of equipment as to the discovery that a twelve or eighteen hours' use of current for other purposes makes three or four hours' illumination much cheaper. The idea of an exclusive lighting plant has been replaced by

that of a light and power plant. Today every effort is being strained to devise twenty-four hour uses, that work even while we sleep.

These examples are only typical of many that will suggest themselves to the reader who will refer to his experience, the scrap heap of mistakes made, but not repeated.

Thousands of civilian engineers throughout the nation are spontaneously responding to the call for engineering preparedness as to defense. The engineer is the man for emergencies because his training and practice has fitted him to anticipate exigencies. The problems of modern military and naval defense are essentially engineering in character, and it is to the engineer that the nation looks in time of crisis.

As a class, there is none more patriotic than the engineer. This is exemplified not only by the loyal assistance being rendered the Naval Consulting Board in its inventory of industrial resources, but also by the earnest study of the principles of military engineering being conducted by many engineers. The survey of manufacturing and productive facilities is of even greater value to the army than to the navy. Knowledge of the rules and methods of warfare is equally indispensable to efficient operation.

Great interest is manifest in military lectures which have been given everywhere in America during the past few months. An engineering corps has been formed in nearly every great center of population. The members are enthusiastically taking up the study of organization and equipment for field maneuvers, investigating methods of offense and defense, mapping, searchlight operation and camp sanitation.

But all of this is only a small beginning. It is only paper warfare. The statistics of manufacturing and producing facilities will be useless unless these facilities are made possible of immediate availment. Every factory should be supplied with blue prints and dies so that machine tools could be instantly put to making implements of warfare instead of implements of industry. Every machinist should know how to make war munitions. Every railroad should be ready for quick conversion into a means for the rapid handling of men and supplies. The mobilization of supplies is fully as important as the mobilization of men and for every man in the field there is necessary another man at the bench.

No factor has added more to America's capabilities of defense than the local manufacture of munitions for the European belligerents. While working for Europe today they are also working for the America of tomorrow. Such enterprise should be encouraged rather than retarded by the proposed waste of eleven million dollars to build a government armor plant, when existing private plants have demonstrated that they can make armor cheaper than the government can do for itself.

The same thought applies to the proposal that the government build an air nitrate factory when private capital is available for this purpose. In times of peace these nitrates are available for fertilizers, in

time of war for explosives. Whereas, the Smith amendment to the Chamberlain bill provides for an appropriation of eleven million dollars for one government owned plant, there is fully one hundred million dollars in private capital available to build nitrate plants if congress will only pass laws permitting the development of unused water powers.

This governmental restriction of water power development brings to mind one phase of preparedness which is apt to be overlooked,—preparedness for peace. It has been repeatedly prophesied that the war will stop as suddenly as it started. Already the faint light of the dawning day of peace is paling the lurid lights of war. The end of military and naval warfare will mark the beginning of industrial competition among the nations.

And American business men are as unready for peace as the American nation was unprepared for war. The "red" in readiness is ever of a paler pink than the red in a preparedness. Instead of being wideawake to peace probabilities, business men are dreaming of war possibilities. Now is the time to mobilize resources for a campaign of trade extension, not only abroad, but at home. The dislocations caused by war will make necessary new adjustments in time of peace.

Therefore let us be alert to both sorts of preparedness. By all means attend one of the military training camps, if possible, but realize that this one month's preparedness for possible war is only incidental to eleven months' readiness for probable peace. The Industrial Trade Commission's survey of the commercial situation is of more lasting benefit than the Naval Consulting Board's inventory of industrial conditions. Familiarity with the rules and methods of business are more indispensable to prosperity than knowledge of those of warfare.

Many managers of small electric light and power companies are overlooking an opportunity for greater sales of their service by not adapting and adopting the sales methods of the large central stations and manufacturing companies. The

The Selling Problem

selling problem has superseded most of the technical difficulties that once beset plant operation. It is not so much the engineering of materials as the engineering of people that concern electric plant progress.

Scientific sales management has established a standard of expectancy as to business in each district. A certain quota is set for each salesman. His method of approach, display and closing is individually watched and suggestions made as to improvement. Some form of incentive, over and above straight salary is provided to encourage the best efforts on the part of each salesman so that he may surpass his quota. In addition, the work of the credit department is co-ordinated with that of the selling department so that the salesman will be advised as to the terms upon which desirable business will be accepted, thus doing away with hard feelings on the part of declined prospects. These principles are as applicable to selling electric service as to selling electric apparatus simply because they embody the issues of all true salesmanship,—service.

PERSONALS

W. P. Naser, Pacific Coast manager Trumbull Manufacturing Company, is at Los Angeles.

E. N. Brown of the Majestic Electric Company, has returned to San Francisco from New York.

C. A. Malone, purchasing agent California-Oregon Power Company, has moved his headquarters to San Francisco.

C. G. A. Baker, vice-president and treasurer Baker-Joslyn Company, has returned from a business trip to Los Angeles.

Paul A. Shilton, representing R. J. Davis, agent for Century motors and fans, has been visiting the cities of Southern California.

Caxton Brown, general manager of the Weston Instrument Company, is expected to visit the Pacific Coast in the very near future.

F. J. Cram, sales manager, Electric Appliance Company of San Francisco, is making a two weeks' trip through Oregon and Washington.

Wm. von Phul of the American Cities Companies, will assume the management of the United Railroads of San Francisco on June 1, 1916.

Samuel H. Taylor of the Electric Railway & Manufacturers' Supply Company, has been on an auto trip throughout the Sacramento Valley.

H. M. Byfliesby, president H. M. Byllesby & Co., and O. E. Osthoff, vice-president, are inspecting the company's Pacific Coast properties.

S. P. Russell, manager electrical department H. W. Johnson-Manville Company, has returned to San Francisco from a business trip to Los Angeles.

A. S. Armstrong, local manager for R. J. Davis, agent for Century single phase motors, has been visiting the towns in Napa and Sacramento Valleys.

Squire V. Mooney, Pacific Coast manager of John A. Roebings Sons Company, has returned to San Francisco from a month's trip in the Northwest.

G. H. Bradt, vice-president of the Wizard Electric Lamp Company, San Francisco, has returned from a trip to New York, and is now at Los Angeles.

Ira J. Wolfe, Pittsburg Electric Specialties Company, has returned to San Francisco from a short business trip in his auto from northeastern California.

Reginaid Duden, formerly with the Pacific Motor Company, is now traveling in Northern California for R. J. Davis, representing Century motors and fans.

T. E. Bibbins, local manager of the General Electric Company at San Francisco, left this week to attend the National Electric Light Association convention at Chicago.

F. E. Boyd, in charge of the small motor department of the General Electric Company at San Francisco, is recovering nicely from an operation for appendicitis.

J. A. Vandegrift, manager of the Oakland Lamps Works of the General Electric Company, has returned to Oakland, Cal., from an extended trip throughout the East.

E. D. Pike, of the Wagner Electric Manufacturing Company, has been appointed manager of service stations at Portland, Seattle, Los Angeles, Salt Lake and San Francisco.

F. H. Leggett, Pacific Coast manager Western Electric Company, and Gerard Swope, vice-president and general sales manager, are making a trip to Seattle and other northern cities.

W. H. Lines of the Portland Railway, Light & Power Company, has gone to Chicago to attend the N. E. L. A. Convention. Mr. Lines will also extend his trip to several Eastern cities.

L. R. Jorgensen, consulting electric and hydraulic engineer at San Francisco, has resumed his work of supervising the construction of two large dams on Rush Creek, in Mono county, California.

Frank E. Smith, Weston Instrument Company, has returned to San Francisco from a two weeks' auto trip mixed with pleasure and business, throughout the northern and central parts of California.

O. E. Thomas, 626 Washington Building, Los Angeles, has been appointed district sales manager for The Terry Steam Turbine Company for Arizona and the southern portions of California and Nevada.

J. R. Wilson, formerly sales manager and vice-president of the Crocker-Wheeler Company of Ampere, N. J., has become associated with the Davison Chemical Corporation of Baltimore, Md., as manager of their office at New York.

S. B. Anderson, of the Pacific States Electric Company, has been spending some time at the branches. During the past three weeks he has been at Seattle and Portland and during the present week is at Los Angeles. He is expected to return to his desk at San Francisco on Monday.

W. A. Blair, who has been with the Pacific States Electric Company almost since its formation, has resigned as secretary and treasurer in order to engage in business on his own account. The financial end, including the credit department, will be under the supervision of S. B. Anderson, with the title of treasurer.

C. H. Carter, who has been in charge of the Los Angeles branch of the Pacific States Electric Company as district manager, has been transferred to the head office, and will devote much of his time to stocks and numerous propositions particularly affecting the branches. At Los Angeles, F. J. Airey, in addition to his duties as sales manager, will direct the affairs of that branch.

MEETING NOTICES.

Oregon Electrical Contractors' Association.

The regular monthly meeting was held in the auditorium of the Electric Building, the evening of May 6th. The paper of the evening was read by Mr. Paul C. Bates on the question of "Compensation."

San Francisco Engineers' Club.

Dr. W. W. Campbell, director of the Lick Observatory gave a popular talk on "The Stellar System" at a mid-day lunch on May 11th. The main point developed that whereas until about a generation ago most astronomical research had been directed to a study of our solar system, recently, improved equipment has made possible a study of the entire stellar system in which our own system is moving at a rate of $12\frac{1}{4}$ miles per second.

Oakland Jovian Smoker.

Nearly two hundred electrical men from the San Francisco Bay region attended a Jovian smoker given in the Commercial Club, Hotel Oakland, May 12th. Tribunes Woodward and Hill had arranged an interesting program of speeches, stories, songs, dances and music, interspersed with moving pictures. Announcement was made by Tribunes Orrick and Wilcox that a joint rejuvenation of San Francisco and Oakland Jovians would be held on June 10th.

The assembly, was the guest of honor at the luncheon on May 10th. A. E. Morphy, vice-president of the league, occupied the chair, and J. W. Thompson, as chairman of the day,

Los Angeles Jovian League.

Alfred L. Bartlett, a prominent attorney and member of had charge of the program. Mr. Bartlett explained the operations of the legislature at Sacramento, in a speech entitled, "Machinery of the Law," interspersing his talk with a number of humorous stories and incidents. In concluding, he

criticized some of the appropriations made by the 1915 legislature in the face of an existing deficit of over \$2,000,000, and stated that as the burden of taxation becomes greater, the public is growing tired of political denunciations, and is demanding constructive statesmanship, and representatives with a zeal for firmness and efficiency of government. The "Rogan Cup," presented to the League by Jas. F. Rogan, Pacific Coast agent, Edison Storage Battery Company, was awarded to C. B. Hall, secretary and treasurer of the Illinois Electric Company. This cup is presented to the chairman of the day "putting over" the best meeting over a period of six months, and the competition was extremely keen, Mr. Hall winning by a slight margin. While some of the programs proved more interesting from the standpoint of entertaining features, the award was made for the best balanced program, on the basis of the following percentages: Attendance 25 per cent, education 40 per cent, speaker 20 per cent and entertainment 15 per cent. It is interesting to note that the Jovian singers furnished the entertainment at this luncheon.

San Francisco Electrical Development and Jovian League.

With W. W. Briggs, general agent Great Western Power Company, in active charge of the May 10th meeting, it was one of the most successful and largely attended of President Cutting's administration. The principal address was made by Max Thelen, president of the California Railroad Commission, who took as his subject "Theory and Practice of Public Utility Regulation in California." After defining the various classes of utilities coming under the commission's jurisdiction he outlined the powers of the commission. The work of the commission, as contrasted with the courts, is characterized by dispatch. Since January 1, 1911, only 22 decisions have been appealed to the courts, and all but three of these were sustained. Since 1913 the commission has won all of the 17 appeals from its rulings. Mr. Thelen characterized the recent San Joaquin and Mt. Whitney rate decisions as the most important yet rendered. He thinks that the lower rates prescribed will make it possible for electric motor pumping to supersede many gas engine installations and hopes that they will ultimately benefit. He mentioned the case of the San Jose Water Company, the expiration of whose corporative life was cared for by transferring all property to a new corporation with the proviso that the new company make no claim for franchise value inasmuch as the franchise cost nothing. He gave warning that if capitalization of franchises were insisted upon, the public would refuse to grant them and arrange to perform the services themselves. He told how, in the case of the San Diego & South-eastern Railway whose past losses in connection with recent floods, made continuance of service difficult, the commission's experts had suggested savings in operating expenses so that it would be possible to resume work. These savings were due primarily to the substitution of street railway operation for interurban cars. He announced that hereafter the commission would supervise and inspect all public utility dams and also provide for the safety of electrical workers by a system of accident reports and prevention. In conclusion he stated that it was the aim of the commission to protect the public and at the same time provide incentive for public utilities to make extensions. Mr. Thelen's remarks were heartily applauded and a rising vote of thanks extended to him and to Mr. Briggs.

California Section of the National Association of Electrical Inspectors.

The regular monthly meeting of the association was held at Stockton, Saturday, May 6, 1916. The question of electric ranges was discussed as there appears to be misunderstanding in sections of the state as to what switch complies with Section 25 of the National Electric Code. These ranges are usually provided with three-heat single pole switches and some have the units individually fused.

Ranges of this character are at times installed without other protection on the assumption that these fuses and switches are the ones referred to in the Code. The Code treats ranges as a complete unit and requires that switch and cut-outs be provided to disconnect and protect all wires of the circuit feeding the range, the switch to be located within sight of the heater.

The question of ground clamps was discussed in detail, several members contending that certain ground clamps used in this territory do not in the smaller sizes properly accommodate No. 6 B. and G. wire, now required on conduit containing service wires. It was the general understanding that overload release devices on starting compensators for a.c. motors do not comply with the requirements of Section 3 (c) of the Code which requires cut-outs for this purpose.

The next meeting of the Association will be held June 3d at Berkeley at which the subject of concentric wiring will be discussed. Samples of this wire and fittings have been received so that an interesting meeting is looked forward to. The departments represented at the last meeting included Stockton, Modesto, Richmond, Sacramento, San Francisco, Berkeley, and the Board of Fire Underwriters.

Utah Electric Club.

At the regular meeting at the Newhouse Hotel, Thursday, May 11, Mr. Lafayette Hanchett, a director of the National Copper Bank of Salt Lake City, addressed the members on the subject "The Fixation of Nitrogen from the Air by Electricity." Mr. Hanchett reviewed briefly the history of the development of this process and described the principal processes in use. He quoted figures showing the amount of power now applied in this industry and brought out the rather surprising fact that only 0.8 per cent of the total power utilized for this purpose is in the United States. The thing which Mr. Hanchett most strongly emphasized was the fact that this country might find itself in a shocking state of unpreparedness, so far as the supply of raw materials, in case it were forced into war with any world power. Our supply of nitrates for manufacturing powder must then be secured from Chili and if our opponent could effectually close this trade route we would find ourselves in a serious situation. Furthermore, that investigation shows, that the production of nitric acid from the air is commercially feasible wherever electric power is available at a rate of \$9 per h.p. per year. That this figure is not likely to prove attractive to private capital in the development of large water powers for this purpose, due principally to the general availability of a higher priced market, he considers it important that the government undertake the development of unused water powers for this purpose. Mr. Hanchett urged all the members of the club to study the subject so that they could talk intelligently on it and interest others so that eventually such a strong sentiment be created in favor of the movement, that the government would be lead to take it up. Mr. Hanchett pointed out that ordinarily he was opposed to the government engaging in such enterprises as are likely to be developed by private initiative, but that he felt that in this case an exception should be made. Mr. Hanchett suggested that the club present a memorial to its representatives in congress urging them to lend their support to such a project. President Armstrong appointed Mr. Hanchett, Mr. B. W. Mendenhall and H. T. Plumb to prepare the memorial.

Portland Sections of A. I. E. E. and N. E. L. A..

At the meeting on Tuesday evening, May 9th, Laul Leberhaum, presided as chairman and the speakers of the evening were W. H. Lines, Portland Railway, Light & Power Company, who gave a talk on "The Electrical Installation of the Western Cooperage Company," in Portland, Oregon, and E. F. Whitney of the General Electric Company, who talked on "The General Application of Electricity to the Logging Industry."

O. B. Coldwell, general superintendent of the Portland Railway, Light & Power Company, and who has been appointed a state director of the organization for industrial preparedness, also outlined the plans for carrying on the work in Oregon. J. B. Fiskien, Washington Water Power Company, was called upon for a few general remarks. Mr. Lines said in part, that the plant is in a general coöperation business. Only about 30 per cent of the timber is manufactured in coöperation products and 70 per cent is waste. Nevertheless the company is selling the greater part of it and buying approximately electric power for 1500 h.p. of motors connected load. The ways that the waste is disposed of includes fuel for steam dry kilns, fuel sold to a wood company for domestic use, chips for paper mill use, ground up fuel for other industrial purposes. The electric motors are direct connected and used for group drive. The company keeps complete figures on costs and uses a graphic ammeter on their switchboard to check up the various mechanical departments. By experience they have found that a certain current is necessary to run each of them at its highest efficiency, and if the current increases and the output does not do so at the proper rate an investigation is made. This is a great "boost" for electric drive as they could not do this with steam.

Mr. Whitney said in part, that the first logging engines using electric motor drive were used by the Potlatch Lumber Company in Idaho. They were equipped with standard I. T. Z. 150 h.p. General Electric motors without any special design. They have been satisfactory and have a greater output to their record than the steam logging engines, the ratio being 47,000 feet per day for steam and 62,000 ft. for electric. They also operate more safely during dry season and longer when the cold weather comes on, as they are not such a fire hazard and no water to freeze in winter. It took about 400 kw-hr. per engine per 52,000 feet per day. Also the C. A. Smith Lumber Company, Marshfield, tried out Westinghouse equipment on some logging engines and were highly pleased. If financial difficulties had not arisen they would have placed a contract for 26 of them. Mr. Lebenbaum could not accept the delegateship for the section to the A. I. E. E. National Convention and Mr. Merwin, superintendent Northwestern Electric Company, was elected to attend. The following committee was appointed to nominate officers for the ensuing year for the local section of the N. E. L. A.: Messrs. Moody, Fear, Bowen, Osborne, Wake-man.

Extraordinary National Institute Meeting.

The most notable national meeting ever conducted by any organization was that held on May 16th by the American Institute of Electrical Engineers, with 6000 members in eight cities participating over the telephone. Promptly at 8:30 p. m., Eastern time, President J. J. Carty called the meeting to order as an adjourned session of the regular annual meeting. Responding to roll-call were Atlanta, with 550 present; San Francisco, with 750; Boston, with 500; Philadelphia, with 650; Chicago, with 1000, and New York, with 1100. Denver and Salt Lake also listened in, but did not talk.

President Carty then extended greetings to the membership, and read President Wilson's message on the subject of the meeting. Announcement was made of new officers elected, and President-elect H. W. Buck introduced, as were likewise Dr. Alexander Graham Bell, Theo. N. Vail, a representative of the British association, and Thomas A. Watson, all of whose remarks were heard distinctly throughout the entire system.

Brief recess was then taken, as far as the transcontinental proceedings were concerned, so that members could listen to addresses by noted speakers at each city. At San Francisco Dr. Ray Lyman Wilbur, president of Stanford University, read an address concerning electricity's contribution

to human welfare, with specific reference to the telephone, automobile, electric light, electric railway, phonograph and electric motor.

In resuming telephonic proceedings, greetings were extended from the several sections, John A. Britton speaking at San Francisco, and then phonograph music was played at each city, so that it could be heard throughout the country. Dr. M. I. Pupin then gave a masterly address on engineering as the noblest of arts, and Ralph W. Pope sent words of greeting. On motion by Professor Harris J. Ryan, the proceedings of the meeting were ordered spread on the minutes, and then was brought to a successful close the most remarkable meeting ever held, six cities simultaneously participating.

The local arrangements at San Francisco were in charge of A. H. Babcock, chairman of the section, who presided at the meeting and talked over the transcontinental line, using a special, sensitive transmitter. Each chair in Native Sons' Hall was equipped with individual receivers, so that the full proceedings were heard by all present.

CALIFORNIA ELECTRIC RAILWAY ASSOCIATION.

The California Electric Railway Association has been organized to facilitate concerted action on franchise and paying questions, to foster a better understanding between the public and the electric railways, to promote co-operation among the railways themselves, to collect and distribute data of value to the railways, and to secure proper regulation of auto competition. G. K. Weeks, president of the San Francisco-Oakland Terminal Railways, Oakland, is president of the association; William Clayton, vice-president and managing director of the San Diego Electric Railway, is vice-president; and W. V. Hill, tax and contract agent of the Pacific Electric Railway, Los Angeles, is manager, with offices in San Francisco. The directors of the association are Mr. Weeks, the president; Mr. Clayton, the vice-president; Paul Shoup, president of the Pacific Electric Company; W. E. Dunn, vice-president of the Los Angeles Railway Corporation, and Jesse W. Lilienthal, president of the United Railroads, San Francisco. Mr. Hill will have a secretary to attend to office matters so his time can be given to paramount issues. Every electric railroad in California is represented, including the electrified steam lines.

NEWS OF IDAHO PUBLIC SERVICE COMMISSION.

James R. Wheeler has been granted a certificate of necessity and convenience to construct an electric light and power system in the towns of Carey and Picalo, Blaine county, Idaho.

At the request of the applicant, the commission has dismissed the application of H. L. Thomas for a certificate of convenience and necessity to construct an electric light and power plant at Lava Hot Springs, Bannock County, Idaho.

NEW CATALOGUES.

The Ward Leonard Electric Company of Bronxville, New York, has issued a new section to be added to their loose leaf catalogue. This is section G-13, which covers their adaptor (plug and socket) resistance units.

"How to Design Effective Lighting" is the subject of No. 6 in the series of salesmen's lamp handbook series being issued by the Westinghouse Lamp Company. Valuable suggestions are given on the artistic lighting of stores and residences.

"The Gateway of Electric Service" is the title of a neat pamphlet published by Pass & Seymour, Inc., wherein electricity is traced from its point of generation to the lighting fixtures, an important part of which is the socket, types of which, as manufactured by this company, are illustrated and described.



NEWS NOTES



INCORPORATIONS.

RIVERSIDE, CAL.—The Riverside County Gas & Power Company has filed articles of incorporation, with principal place of business at Beaumont. The capital stock is \$100,000. The directors are Nathan W. Tarr of Sierra Madre, Henry W. Burkhart of Los Angeles, Frederick N. Hawes of Monrovia, Kenneth R. Smoot of Beaumont and De Roy H. Gates of Banning.

SALEM, ORE.—To promote industrial waterpower development for electrical energy for the production of atmospheric nitrogen and its fixation with lime and other minerals and organic materials, and for the production and manufacture of acids, the Deschutes Hydroelectric Process Company, with headquarters in Portland, has been organized. The company is capitalized at \$350,000. The incorporators are John A. Jeffrey, C. D. Charles and E. Z. Ferguson of Portland.

ILLUMINATION.

FLORENCE, ARIZ.—All bids received by the city council for water and light bonds have been rejected.

DINUBA, CAL.—The River Bend Gas & Water Company of Parlier is extending its gas mains from Parlier to Kingsburg.

LOS ANGELES, CAL.—The board of public service commission will receive sealed bids for incandescent lamps up to May 23d.

IDAHO FALLS, DAHO.—D. T. Murphy has been looking over the field at Dubois with a view to establishing a light and water plant.

OAKLAND, CAL.—Sealed bids will be received by the city clerk up to June 1st for 24 lighting posts to be constructed on Grove street.

LOS ANGELES, CAL.—The report of the lighting committee of the Van Nuys lighting district, submitting demand for work, has been approved by the board of supervisors.

REPUBLIC, WASH.—The Laurier Mining Company has applied to the commissioners of Ferry county for a franchise to construct light and power lines on the public roads of the county.

SANTA BARBARA, CAL.—The city council has given permission for the placing of a sample concrete lighting post here, that citizens may have the opportunity to inspect it. The company offers to install light posts at \$18 each.

TURLOCK, CAL.—The city council has under advisement an offer of the Yosemite Power Company to reduce rates on street lighting and power for the city water works amounting to \$1600 a year if the board will make no effort to disturb domestic rates for light and power.

LOS ANGELES, CAL.—The first move toward installing arc lights using aqueduct power has been made by the city electrician. In a petition to the council the electrician asks that provision be made for the installation of some 800 lights on the East Side where a municipal power distributing plant is now being installed.

TRANSMISSION.

TAFT, CAL.—The San Joaquin Light & Power Company is installing two miles of pole line to connect power with the Nacirema lease in the McKittrick field.

OAKDALE, CAL.—The Oakdale irrigation district proposed to establish a large power plant in the mountains in connection with its storage system.

LOS ANGELES, CAL.—The offer of the power companies operating here to buy all the city aqueduct power for \$750,000 per annum has been rejected by the city council.

OROVILLE, WASH.—The Okanogan Power Company has acquired the holdings of the Similakameen Power Company and is extending the system to Mansfield and other near-by points.

OAKLAND, CAL.—The annual report of the Great Western Power Company announces that the company contemplates erecting a second tower line from the Feather River plant to Oakland as well as a second power house on the Feather River.

RIVERSIDE, CAL.—Negotiations have been concluded between the Southern Sierras Power Company and the Tungsten Mines Company, whereby the power requirements of the latter company in the operation of its mines and mills near Bishop, will be supplied from the lines of the Sierras Company.

PORTLAND, ORE.—The Pacific Power & Light Company announces that the sum of \$260,000 will be expended this summer in the state of Washington in new improvement work, the largest expenditure being the installation of a concrete substation to cost \$75,000 at North Yakima, Wash. A 22,000 volt transmission line is also to be built from Warrenton to Seaside, a distance of nine miles, at a cost of \$22,000.

CARRIZOZO, N. M.—The Alto Light & Power Company, with headquarters at White Oaks, has disposed of its holdings, including a coal mine on which was a power plant that furnished power to the mine and mills as well as light for the town and two transmission lines for power and light. The transfer will take place on July 1st. J. H. Fulmer, Jr., president of Parsons Milling Company, and associates are the purchasers and the company will continue to operate under the original corporation title.

TELEPHONE AND TELEGRAPH.

NAPA, CAL.—Stanley M. Long and others have been granted a temporary permit to erect a telephone line in the Lodi Road District.

FOWLER, CAL.—Lack of a quorum prevented the annual meeting of the Fowler Independent Telephone Company doing other business than to receive the annual reports. The present board of directors will hold over for another year.

TRANSPORTATION.

SAN FRANCISCO, CAL.—The San Francisco - Oakland Terminal Railways proposes to buy 36 new cars, including 20 steel cars of the pay-as-you-enter type. The cost is estimated at \$234,000.

MARTINEZ, CAL.—The board of trustees refused to open bids on the franchise requested by the Martinez-Concord Interurban Railway Company as the result of protests received by residents.

FLAGSTAFF, ARIZ.—Rumors are in circulation that Los Angeles and Phoenix capitalists back of the Phoenix Street Railway Company, contemplate building an electric interurban railway from Flagstaff to Grand Canyon.

STOCKTON, CAL.—The city council has passed an ordinance granting the Tidewater & Southern Railway Company authority to electrify certain portions of the railroad tracks of the Western Pacific Railway Company.

ALAMEDA, CAL.—Councilman J. H. Wilkins is endeavoring to have the San Francisco & Oakland Terminal Railways install a spur track from Santa Clara avenue to Central avenue, on Webster street, and thus give direct service from Oakland to the beaches.

ALPHABETICAL INDEX TO ADVERTISERS

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- A-2 Atchison, Topeka & Santa Fe Railway Co.....
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- B-1 Baker-Joslyn Company.....
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JOURNAL OF ELECTRICITY

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PACIFIC COAST HYDROELECTRIC DEVELOPMENT.

BY JOHN HARRISBERGER.

FIRE PROTECTION OF ELECTRIC PLANTS.

BY M. E. CHENEY.

FEASIBILITY OF ELECTROCHEMISTRY AT THE DALLES.

BY O. F. STAFFORD.

SALIENT FEATURES OF N. E. L. A. PAPERS.

MATERIALS ADVERTISED IN THIS ISSUE

Batteries

Edison Storage Battery Co.
Electric Storage Battery Co.

Boiler Feed Water Treatment

Dearborn Chemical Company.

Conduit and Loom Boxes

Sprague Electric Co.

Electrical Supplies

Electrical Ry. & Mfrs. Supply Co.
Pacific States Electric Co.

Insulator Pins

McGlauffin Mfg. Co.

Insulators

Baker-Joslyn Co.
Hemingray Glass Co.
Pierson, Roeding & Co.

Lamps

National Lamp Works.

Motors

Century Electric Co.
Crocker-Wheeler Co.
Wagner Electric Mfg. Co.

Oil Burners

Leahy Manufacturing Co.

Ornamental Lighting Units

General Electric Co.

Piping

Pittsburg Piping & Equipment Co.

Porcelain Knobs

Baker-Joslyn Co.

Protective Devices

Cutler-Hammer Mfg. Co.

Power Plants

Chas. C. Moore & Co.

Ranges and Signs

Federal Sign System (Electric).

Shades and Reflectors

Pacific States Electric Co.

Transportation

Southern Pacific Co.

Turbines

Pelton Water Wheel Co.

Turbo Generators

Westinghouse Elec. & Mfg. Co.

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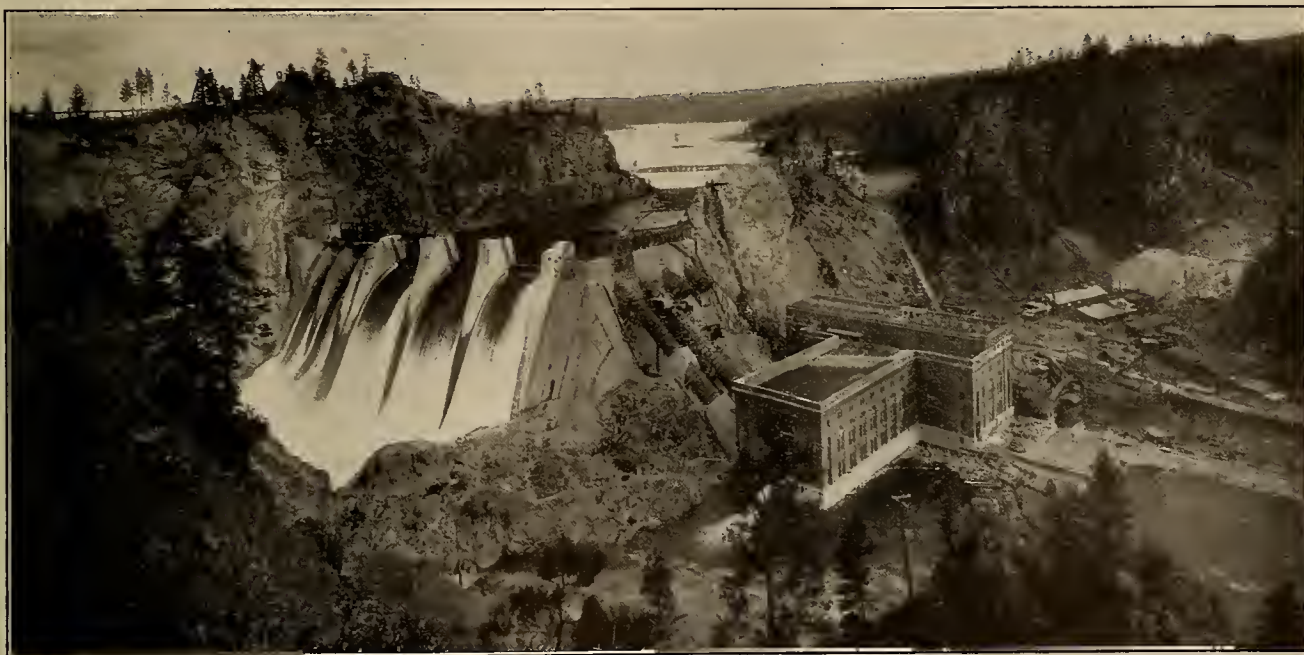
PACIFIC COAST HYDROELECTRIC DEVELOPMENT

BY JOHN HARISBERGER.

(This comprehensive summary of typical operating conditions is slightly condensed from a paper presented at the 39th convention of the National Electric Light Association, Chicago, May 22-26, 1916. The author is superintendent of water power Puget Sound Traction, Light & Power Co., Seattle.—The Editor.)

The Pacific States are conservatively estimated to possess eight million kilowatts of kinetic energy in the form of flowing water available the year around, and if efficient storage methods were to be utilized the power output could be increased five times, making an ultimate output of forty million kilowatts. How-

Electrical development in Washington, Oregon and California at present totals about 800,000 kilowatts with a one-hour peak capacity of 900,000 kilowatts and with hydraulic development sufficient to give about a million kilowatts by simply adding the necessary generating units. The demand for electric power has



Washington Water Power Company's Long Lake Plant.

ever there are but three plants of the one hundred and sixty-eight now operating on the coast, where there is sufficient water to carry the rated load 365 days in the year and utilize the greatest part of the annual river flow. This is due to the excessive cost involved in providing a storage basin that will conserve the flood waters and to the fact that a very small percentage of the available energy is needed to supply the demand for power at present. It has been much more economical to install a number of small plants utilizing the minimum river flow than to intensively develop a few large installations with a view to conserving the total energy in the river.

not increased at the rate that was estimated four or five years ago, and as a result of the depressed business conditions of the past few years, most of the systems have now a large surplus of power electrically developed and an additional 25 per cent hydraulically developed. For example, one plant in eastern Washington is now completed and lies inoperative for want of load, awaiting the coming of industries which will absorb its output. Under such conditions the price of electricity on the coast is the lowest anywhere in the United States, being supplied at \$30 per h.p.-year to loads as small as 100 h.p. and coming close to \$12 per h.p.-year for large quantities on a wholesale basis

These figures are dangerously close to the cost of production and it is the exceptional utility which has yielded more than 3 or 4 per cent on the investment during the last five years. However, a resumption of prosperous business conditions in the West and the electrification of the transcontinental railroads will quickly absorb the present surplus and make necessary the further development of available water power; and particularly is this true in Washington, which state

Hydroelectric Development on the Pacific Coast.

	Plants.	Hydroelectric Capacity. kw.
British Columbia—		
British Columbia Electric Railway Co., Ltd..	3	60,000
Western Canada Power Co. Ltd.....	1	36,000
West Kootenay Power & Light Co., Ltd....	2	9,000
Bull River Electric Power Co., Ltd.....	1	9,000
Miscellaneous small plants.....	5	1,000
Total	12	115,000
Washington—		
Puget Sound Traction, Light & Power Co..	4	55,000
Washington Water Power Co.....	3	41,000
Not operating at present.....	1	38,000
Tacoma Municipal Plant.....	1	20,000
Pacific Power & Light Co.....	10	14,000
Seattle Municipal Plant.....	2	15,000
Olympic Power Co.....	1	6,000
Wenatchee Gas & Electric Co.....	1	3,000
Miscellaneous small plants.....	25	8,000
Total	48	200,000
Oregon—		
Portland Railway, Light & Power Co....	4	43,000
California-Oregon Power Co.....	7	62,000
Northwest Electric Co.....	1	13,000
Eastern Oregon Light & Power Co.....	5	4,000
Hanford Irrigation & Power Co.....	1	1,600
Eugene Municipal Plant.....	1	1,400
Miscellaneous small plants.....	25	10,000
Total	44	135,000
California—		
Pacific Gas & Electric Co.....	11	82,000
Pacific Light & Power Co.....	6	80,000
Great Western Power Co.....	1	50,000
Northern California Power Co.....	7	37,000
Sierra & San Francisco Power Co.....	3	34,000
Southern California Edison Co.....	5	27,000
San Joaquin Light & Power Co.....	4	25,000
Los Angeles Municipal Plant.....	1	22,000
Southern Sierras Power Co.....	5	19,000
Arrowhead Reservoir & Power Co.....	1	15,000
Mt. Whitney Power & Electric Co.....	4	6,000
Snow Mountain Water & Power Co.....	1	6,000
Pacific Power Co.....	1	3,000
Oroville Electric Corporation.....	1	3,000
Western States Gas & Electric Co.....	1	3,000
Holton Power Co.....	2	1,000
Ontario Power Co.....	1	1,000
Yosemite Power Co.....	1	1,000
Miscellaneous smaller plants.....	20	5,000
Total	76	420,000
Grand total, British Columbia, Washington, Oregon and California.....	180	886,000
Total Washington, Oregon and California.	168	755,000

has more available hydraulic energy than any other in the Union and about one-fifth of the total in the United States.

With the undeveloped water powers now indefinitely tied up in litigation and controversies between federal and state governments, and with various regulatory bills now pending in congress, we face the problem of intensifying our present developments and of making our future projects the most efficient possible. It is possibly true also that the most readily accessible water sites and those offering the cheapest development have all been utilized, and most of the remaining projects will require enormous capital to put the energy on the market. These conditions bring to our attention the generation of electricity by other prime movers than hydro-motors and to the improvement of efficiency in our present plants, and it seems appropriate to discuss at this time the general characteristics of the systems operating on the Pacific Coast, the distribution of load among the several plants in a system and the manipulation of storage facilities.

Northwestern Companies.

The Washington Water Power Company of Spokane, operates three plants on the Spokane River; Post Falls, Spokane City and Little Falls. The system extends in and about Spokane, a city of 100,000 population, east to Lake Pend O'reille, west to Harline and south to Colfax, some 300 miles of transmission lines. The power is generated about the center of the system and fed out over radial lines to the consumers. The energy is supplied to farmers and farming communities, irrigation pumps, cement mills, city and interurban railways and for commercial light and power. Apples, peaches and other fruits are grown extensively to the east of Spokane and require irrigation, while to the west and south wheat is the leading crop and is raised on dry land. The principal market is the farming country and this of course makes long transmission necessary with relatively few customers per mile, but it is mostly continuous and off-peak power. Added to this outside load is the city light and power load and the railway, which have the usual characteristics. This makes up to a total load with the unusually high daily load-factor of 85 per cent, and necessitates only small pondage facilities, which condition obtains. Coincident with low water, the summer load falls to 75 per cent of the winter load, requiring a river flow of nearly constant amount. This not being the case with the Spokane River, any development above the minimum river flow would necessitate a large storage basin to draw on in summer. This company is developing such a plant. In general, the Post Falls plant carries a continuous load with nearly 100 per cent load factor and the regulation of the system is carried on the Little Falls plant, which by reason of more modern machinery is the most convenient method. The Spokane plant is small and carries but a small part of the load. A 14,000 kw. coal burning steam plant is held as emergency reserve, but never has to be used. There is no effort made to distribute load among the most efficient units first, nor is it possible to manipulate any storage. The pondage is about sufficient to pull over the small peak.

The Puget Sound Traction, Light & Power Company operates one of the representative systems of the Northwest, extending from Tacoma, Washington, north to the Canadian boundary, a distance of 150 miles and including a network of transmission lines. Five hydroelectric stations on five different rivers feed the system at as many points, viz: Electron from the south, Snoqualmie from the east, White River at the "center of gravity," Nooksack from the northeast, and Stave Lake from the north. Stave Lake plant is in Canada and is operated by the Western Canada Power Company, which sells power to the Puget Sound Traction, Light & Power Company at the Canadian boundary and also carries a large load in and about Vancouver, B. C. It will be noted that in the Puget Sound Traction, Light & Power Company system the generating plants are all except one located on the outskirts of the system and feed in toward the center, whereas with the Washington Water Power Company the converse is true.

The market for power and the nature of the load are very different on Puget Sound and the average

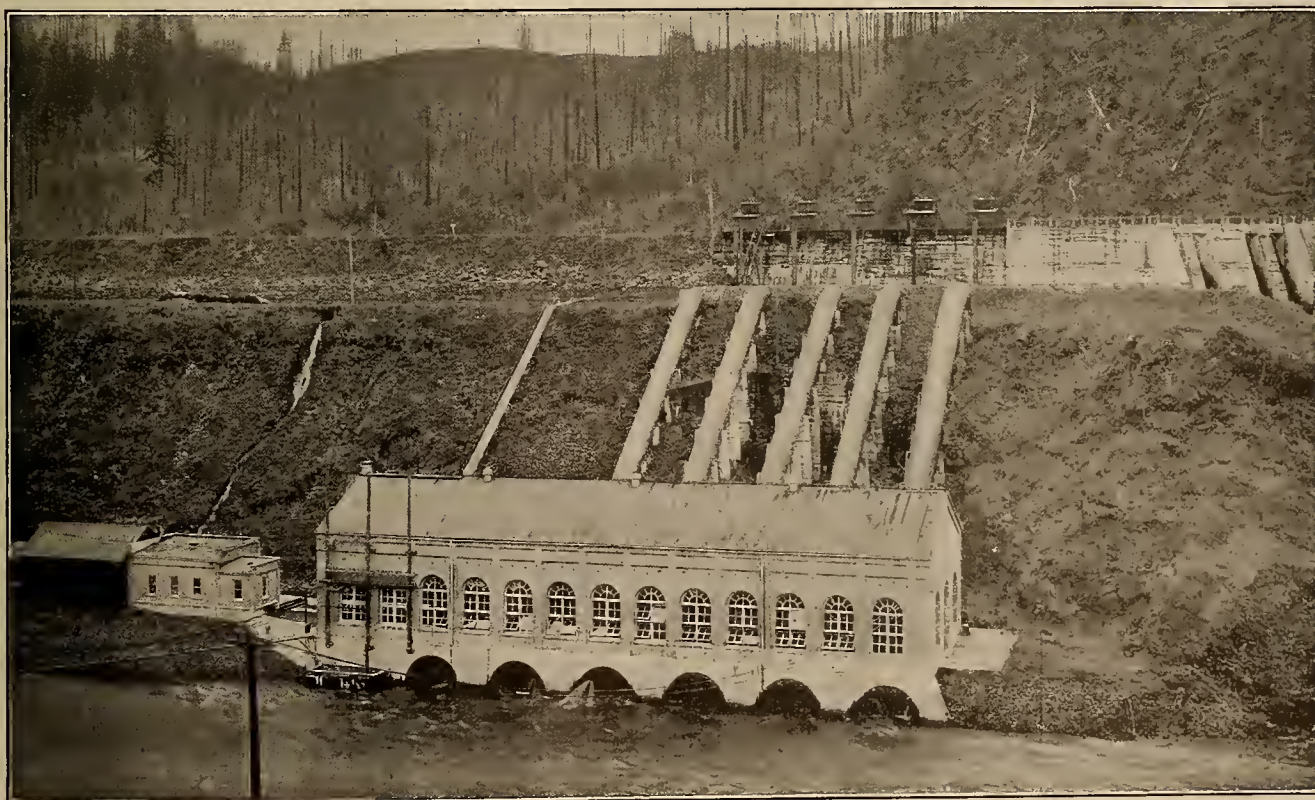
load factor is 65 per cent as against 85 per cent in the eastern part of the state. The bulk of the people live in small towns and the cities of Seattle and Tacoma, and the chief business of the central station is to supply their demands in these places. The lumber industry leads in value of products, but as yet the use of electricity in logging and in transporting logs from the forests to the mill is only an experiment, steam power being used for this work. The cost of the wood fuel is little or nothing. The best lumber mills are driven by individual electric motors, but the power can be supplied from the mill's own steam plant far cheaper than a hydroelectric company can sell it, for the fuel not only costs nothing, but it is an asset to have this means of disposing of the waste lumber and sawdust. These factors have eliminated the lumber business from the central station market, but arrangements have just been made to supply certain of the large mills with central station service during such periods as there is an excess of water available; the mill to maintain its own steam plant ready for operation on 48 hours' notice. Transportation and commerce are also driven by steam power, although the near future bids fair to bring the railroads into the electrical market. This leaves only the possibility of furnishing power to small miscellaneous manufacturing, city and interurban railroads and commercial activities, all of which are in operation during the daytime and evening and are off between midnight and morning.

The characteristics of such a load are a high morning peak about 8 o'clock, a small drop at noon and then the highest peak at 6 p. m., with the load falling off rapidly until midnight and a very small load until 6 a. m. To answer such requirements, the hydroelectric system has a large installed machine capacity with pondage facilities which through the dry season



Mt. Rainier from Electric Flume of Puget Sound Traction, Light & Power Company.

store sufficient water during the night to carry the peak loads. A further refinement was made in developing the White River plant to carry a continuous load of 24,000 kw. by using the large storage in Lake Tapps and operating the other plants only during the peak periods. A central load dispatcher supervises the operation of all plants, and distributes the load as it develops. Only when water is very scarce is any effort



Portland, Railway, Light & Power Company's Cazadero Plant.

SYSTEM DATA.

System.	Location.	Nature of Load.	Transmission Voltage.	Average Transmission Line Loss.	Rated System Capacity 24 hr. Day, kw.	Peak System Capacity 1 hr. per Day, kw.	Av. 24 hr. Daily Load in Annual Peak Period, kw.	Av. 24 hr. Daily Load in Annual Minimum Period, kw.	Daily Peak in Annual Peak Period, kw.	Daily Duration of Peak.
Pacific Gas & El. Co.....	No. Central California.	General L. & P.	110000 60000 24000 17000	17.8%	170200	206500	87500	82500	130000	5:30 p.m. to 7:00 p.m.
Pacific L. & P. Corp.....	Southern California.	1/3 Com'l. L. & P. 2/3 City & Sub. Ry.	150000 60000 50000 15000	20%	110000 ..... ..... .....	..... ..... ..... .....	35900 ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....
So. Cal. Edison Co.....	Los Angeles and So. California.	General L. & P.	66000 33000 10000	15%	86150	90000	40000	32000	52000	5:30 p.m. to 8:00 p.m.
Puget Sound Traction... Light & Power Co ...	Tacoma to Bellingham, Wash.	Com'l & Res. L. & P. Mfg., Mines & Mills, Street Rys.	55000 13800 6600	10%	60000	85000	42800	30400	66000	5:00 p.m. to 6:00 p.m.
Great Western Pr. Co....	Central California.	General Power & Lighting.	100000	10%	70000	80000	40948	35644	62100	5:30 p.m. to 6:00 p.m.
Portland R., L. & P. Co...	Portland, Ore., and vicinity.	Com'l L. & P. & City & Suburb Railway.	60000 57100 33000 11000	8%	58380	72520	24500	19300	38300	5:00 p.m. to 6:00 p.m.
Wash. Water Power Co...	Spokane and vicinity, Washington.	Com'l L. & P. St. Ry., Mining.	60000	10%	54550	68187	24200	18000	28691	5-6 p.m.
San Joaquin L. & P. Co...	California.	Com. & Ind. Pr. Ry. & Ltg.	60000 30000	16.72%	43980	48600	13800	10000	19800	8-8:30 p.m.
Western Canada P. Co....	In and around Vancouver, B. C., and S. to Blaine, Wash.	Com'l L. & P., Res., City & Int. Rys.	60000	.... ..... ..... .....	36000	50000 ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....
So. Sierras P. Co.....	Nevada and California	Mining. Mfg. Irrigation.	55000 now 110000 ult.	16%	16800	21300	18000	15500 ..... ..... .....	.... ..... ..... .....	9 a.m. to 11:00 a.m.

PLANT DATA.

Plant.	Location.	Name of River.	Approx. Length of River-Source to Intake, Miles.	Nature of Source.	Drainage Area, Sq. Miles.	Capacity, Acre Feet.	Av. Length, Miles.	Av. Width, Miles.	Kw.-hr. per Ac. Ft.	Kw. per Sc. Ft.
Pacific Gas & El. Co.....	Alta .....1 California									
	Placer County.									
Centerville	T 16 N, R 10 E, Sc 25.	Boardman Canal.	40	Natural	121	None	....	....	....	20
Colgate	On Butte Creek	Butte Creek.	25	Springs	61	Sec de Sabla.	....	....	....	40
Deer Creek.....	Sec 5, T 22 N, R 3 E.	Yuba River.	40	Springs So. Yuba	483	.....	....	....	....	40
de Sabla	Yuba County.	Lake Francis.	40	Watershed	121	1.72	....	....	....	40
Drum	Sec 16, T 17 N, R 7 E.	Chalk Bluff.	40	Lakes & Springs	108	St. 878	....	....	....	85
Electra	Sec 34, T 17 N, R 10 E.	Canal.	40	Lake.	121	Pd. 252	....	....	....	80
Folsom	Sec 10, T 23 N, R 3 E.	Butte Crk., Feather R.	18	Lakes & Springs	332	117	....	....	....	55
Halsey	Placer County.	Lk. Spaulding, So Yuba	40	Lakes & Springs	...	None	....	....	....	3
Newcastle	Sec 17, T 16 N, R 11 E.	Mokelumne.	45	Springs, Watershed	121	150	....	....	....	20
Wise	Sec 32, T 6 N, R 12 E.	American.	55	So. Yuba Watershed	121	None	....	....	....	3
Oakland	Amador County.	So. Yuba Water Sys.	40	So. Yuba Water Sys.	121	376	....	....	....	30
Sacramento	Sec 30, T 12 N, R 8 E.	Boardman Canal.	40	So. Yuba Water Sys.	121	None	....	....	....	3
San Jose	Auburn, Placer County.	So. Yuba Water Sys.	40	So. Yuba Water Sys.	121	None	....	....	....	30
San Francisco.....	Oakland.	Steam.								
P. L. & P. Corp.	Sacramento.	Steam.								
Sierra	San Jose.	Steam.								
Mentone	San Francisco.	Steam.								
Borel	35 mi. E of Los Angeles.	San Antonio Creek.	5.75	Natural Drainage	18	None	....	....	....	34
Azusa	70 mi. E of Los Ang.	Santa Anna.	15	Natural Drainage	182	None	....	....	....	18
Big Creek No. 1.....	120 mi. N. of Los Ang.	Kern.	78	Natural Drainage	1220	None	....	....	....	13.8
Big Creek No. 2.....	20 mi. E of Los Ang.	San Gabriel.	25	Natural Drainage	222	None	....	....	....	17.5
Redondo	45 mi. N E of Fresno.	Big Creek.	14	Natural Drainage	88	51500	4	0.43	1623	130
	45 mi. N E of Fresno.	Big Creek.	16	Natural Drainage	113	1053	....	....	1490	121
		Pittman Creek.	7							
		Steam.								

	Daily Peak in Annual Minimum Period, kw.	Daily Duration of Peak.	Annual Peak Period.	Annual Minimum Period.	Annual Low Water Period.	Low Water Seasonal or Annual?	Is Load Distributed by Load Dispatcher?	Is Gen. Sta. Nearest to "Center of Gravity" of System kept Loaded?	Are Most Efficient Units Loaded First?	Is the System Regulation Carried on Steam of Hydro?	Are Steam Plants at Center of Load?	Use of Steam Plants.	Do Steam Plants Make up kw.-hr. or kw.?	Average Daily Load Factor.
	118000	6:00 p.m. to 7:00 p.m.	Sept. to Nov. Incl.	Jan. to Mar. Incl.	Oct. to Dec. Incl.	Annual	Yes	Yes	Yes	Hydro	Center of Load	Emergency Stand by and Low Water		65%
							Yes				Near Water			50%
	46000	5:30 p.m. to 8:00 p.m.	Sept. 1 to Jan. 1 Evening	Jan. 1 to June 1 Evening	Aug. 15 to Jan. 15	Annual	Yes	No	Yes	Steam	Near Water	One Plant entire year. Two Plants Stand by	Kw-hr.	75%
	43000	5:00 p.m. to 6:00 p.m.	Dec. 15 to Dec. 31	Apr. 15 to Apr. 30	Aug. 15 to Sept. 15	Annual	Yes	No	Yes	Hydro	Center of Load	Stand by only Emergency	Peak kw.	65%
	53000	8:30 p.m. to 9:00 p.m.	Oct. to Dec. Incl.	Jan. to March Incl.	July to Dec. Incl.	Annual	Yes	No	Yes	Hydro	Center of Load	Emergency Stand by	Peak kw.	65%
	27700	5:00 p.m. to 6:00 p.m.	Dec. 15 to Jan. 15	Aug. 1 to Sept. 1	July 15 to Oct. 1	Annual	Yes	No	Yes	Hydro	Center of Load	Emergency Stand by Low Water	Peak kw.	65%
	23879	10:30 to 11:30 a.m. 7:30-8 p.m.	Dec. to Feb.	July to Sept.	Aug. to Nov.	Annual	Yes	No	No	Hydro	Center of Load	Emergency		85%
	16000	6 to 6:30 p.m. or 9 to 10 a.m.	July to Oct.	Dec. to Feb.	Aug. to Nov. Mar. 1 to Mar. 31	Annual	Yes	No	No	Hydro	Center of Load	Emergency Standby and Low Water		65%
		9 a.m. to 11 a.m.	May to Sept. Incl.	Oct to Apr. Incl.	Oct. to Mar. Incl.	Annual	No	No	No Choice	High Water by Hydro Low Water by Steam	Center of Load	Emergency and Low Water		75%
	Max. Head, Feet.	Minimum Head Feet.	Effect of Variation in Head.	Generating Voltage.	Transmission Volts Out of Plant.	Rated Plant Capacity, 24-hr. kw.	Peak Plant Capacity, 1 hr., kw.	Sufficient Water to Operate Plant, Rated Load Throughout the year?	Is it Necessary to Draw on Storage to do This?	Pondage—Daily hrs. of Draw Out.	Pondage—Daily hrs. of Fill Up.	Steam Plant Type of Prime Mover.	Fuel.	
Alta	660	660	None	500	60000	2000	2000	No		8:00 to 11:00 a.m. 2:00 to 5:00 p.m.				
Centerville	577	577	None	2300	22000 60000	6400	6400	No		8:00 to 11:00 a.m. 1:00 to 5:00 p.m.				
Colgate	700	700	None.	2300	60000 30000	10700	13000	No		8:00 to 11:00 a.m. 2:00 to 5:00 p.m.				
Deer Creek	837	837	None	2300	60000	4000	5000	No		8:00 to 11:00 a.m. 2:00 to 5:00 p.m.				
de Sabla	1531	1531	None	2300	60000	12300	12500	No		8:00 a.m. to 1:00 p.m. 2:00 to 5:00 p.m.				
Drum	1375	1375	None	6600	110000	16000	25000	No		8:00 to 11:00 a.m. 1:00 to 5:00 p.m.				
Electra	1467	1267	None	2300	60000 17000	10800	17000	No		8:00 to 11:00 a.m. 1:00 to 5:00 p.m.				
Folsom	55	26	None	800	60000	3750	3750	No		8:00 to 11:00 a.m. 1:00 to 5:00 p.m.				
Halsey	340	315	None	6600	110000 60000	9000	12500	No		8:00 to 11:00 a.m. 1:00 to 5:00 p.m.				
Newcastle	464	464	None	500	60000	570	900	No		8:00 to 11:00 a.m. 1:00 to 5:00 p.m.				
Wise	519	499	None	6600	60000	6500	12500	No						
					Oakland 14000	18000						Curtis Turbine	Oil	
					Sacramento 5000	6500						Parsons Turbine	Oil	
					San Jose 2500	2500						Recip. Lamp	Black	
					San Francisco 34000	45000						Curtis Trb. & Eng.	Oil	
Sierra	628	....	.....	500	15000	....	650	No				Redondo, Curtis Trb. Recip.	Oil
Mentone	352	....	.....	2200	15000	....	1550	No					
Borel	262	....	.....	2200	50000	....	10000	No					
Azusa	400	....	.....	500	150000	....	1625	No					
					Redondo 40000	....							
Big Ck. 1	2009	1924	None	6600	150000	....	32000	Yes	Yes				
Big Ck. 2	1815	1796	None	6600	150000	....	32000	Yes	Yes				

PLANT DATA—Continued.

Plant.	Location.	Name of River.	Approx. Length of River-Source to Miles Intake.	Nature of Source.	Drainage Area, Sq. Miles.	Capacity, Acre Feet.	Av. Length, Miles.	Av. Width, Miles.	Kw.-hr. per Ac. Ft.	Kw. per Sq. Ft.
So. California Edison Co.										
Kern River No. 1....	Kern County. Sec. 29, T 28 S, R 20 E.	Kern.		Lakes and Springs	2330	Not Avail. 92	....	....	....	56
Mill Creek No. 1....	San Bernardino County. Sec. 14, T 15 S, R 2 W.	Mill Creek.	35	Springs and Snow	45	7	....	....	....	30
Mill Creek No. 3....	San Bernardino County. Sec. 12, T 1 S, R 2 W.	Mill Creek.	30	Springs and Snow	19	7	....	....	....	126.5
Santa Anna No. 1....	San Bernardino County. Sec. 26, T 1 N, R 2 W.	Santa Anna.	30	Bear Lk. Reservoir	180	Controlled by Water Co.	....	....	....	41.0
Santa Anna No. 2....	San Bernardino County. Sec. 34, T 1 N, R 2 W.	Santa Anna.	35	Bear Lake	159	ditto	....	....	....	19.5
Long Beach	Long Beach.	Steam.								
Los Angeles No. 3....	Los Angeles.	Steam.								
P. S. T., L. & P. Co., Seattle Division.										
White River.....	Sec. 7, T 20 N, R 5 E, White. WM.		40	Glaciers	424	36800	....	....	326	27
Snoqualmie	Secs. 19 and 30, T 24 N. WM.	Snoqualmie.	40	Lakes and Springs	400	450	2.46	0.047	172	14.2
Electron	Sec. 33, T 18 N, R 5 E, WM.	Puyallup & Mowich.	12	Glaciers	90	88	....	....	562	46.5
Georgetown	Seattle.	Steam.								
Post Street	Seattle.	Steam.								
Bond St., Everett.....	Everett.	Steam.								
Nooksack	Nooksack Falls.	Nooksack.		Glaciers	...	....	....
York St.	Bellingham.	Steam.								
Purchased	Blaine.	Hydro.								
Great Western P. Co., California.										
Big Bend	Las Plumas. Butte County, Cal.	No. Fk. Feather River.	50	Springs	1940	240000	7.5	4	225	27
Oakland S. P.....	Oakland.	Steam.								
San Francisco.....	San Francisco.	Steam.								
Portland Ry., Lt. & Pr.										
River Mill	Near Estacada, Ore.	Clackamas.	55	Spring	685	1215	2.5	0.045	54.45	4.5
Oregon City.....	Oregon City.	Willamette.	150	Springs	10200	600	3	0.11	Variable	
Cazadero	Cazadero.	Clackamas.	50	Spring	685	688	0.5	0.19	72.6	6.0
Bull Run	Bull Run.	Big Sandy.	19	Glacier	....	2964	.75	0.38	187.55	15.5
North Portland.....	Portland.	Steam.								
East Portland	Portland.	Steam.								
St. Johns		Steam.								
Salem	Salem, Ore.	Steam.								
Washington W. P. Co.										
Post Falls	Post Falls, Idaho.	Spokane.	9	Lake	3662	161150	30	1.5	42.5	3.5
Spokane Pr. St.....	Spokane.	Spokane.	36	Lake	4043	None	....	....	34.2	3.1
Little Falls.....	15 mi. N. of Reardon.	Spokane.	72	Lake	5903	1740	4	.75	55	4.6
San Joaquin L. & P.										
San Joaquin No. 1....	S 18, T 9 S, R 23, E, Cal.	No. Fork San Joaquin.	19	Creeks	95	51000	2	0.25	1080	90
San Joaquin No. 3....	S 12, T 8 S, R 22 E, Cal.	No. Fork San Joaquin.	16	Creeks	78	51000	2	0.25	324	27
Tule	S 26, T 20 S, R 30 E, Cal.	Tule.	9	Creeks	34	None	....	....	1120	93.5
Kern Canyon.....	S 6, T 29 S, R 30 E, Cal.	Kern.	100	Lakes and Springs	7	None	....	....	156	13
Bakersfield	Bakersfield.	Steam.								
Fresno	Fresno.	Steam.								
Santa Maria	Santa Maria.	Steam.								
San Luis Obispo.....	San Luis Obispo.	Steam.								
Western Canada P. Co..										
Stave Lake	35 mi. E of Vancouver.	Stave.	7	Glaciers	450	360000	9	1.5	....	....
Southern Sierras P. Co.										
No. 2 Nev.-Cal. P. Co.	Sec. 9, T 8 S, R 31 E, Bishop Creek. MDM.		5	Lakes	38.3	Hillside Res. 13100	1.25	0.3	....	33
No. 3 Nev.-Cal. P. Co.	Sec. 36, T 7 S, R 31 E, MDM.	Bishop.	7	Lakes	38.3	No. 1 Res. 8000	1.0	0.5	....	45
No. 4 Nev.-Cal. P. Co.	Sec. 19, T 7 N, R 32 E, MDM.	Bishop.	9	Lakes	38.3	Ditto	....	....	....	58
No. 5 So. S. P. Co.	Sec. 17, T 7 S, R 32 E, MDM.	Bishop.	11	Lakes	38.3	Ditto	....	....	....	21
No. 6 So. S. P. Co.	Sec. 9, T 7 S, R 32 E, MDM.	Bishop.	31	Lakes	38.3	Ditto	....	....	....	14.3
S. S. P. Co.....		Steam.								

made to load up the most efficient units first, and with comparatively short transmission lines and low losses, the best combination of stations for the existing conditions at any minute is selected. All stations are synchronized and run in parallel; energy sometimes flows in one direction over a transmission line and sometimes in the opposite. The possibilities of storage manipulation are very limited, but in general the attempt is made to use all the water possible from the

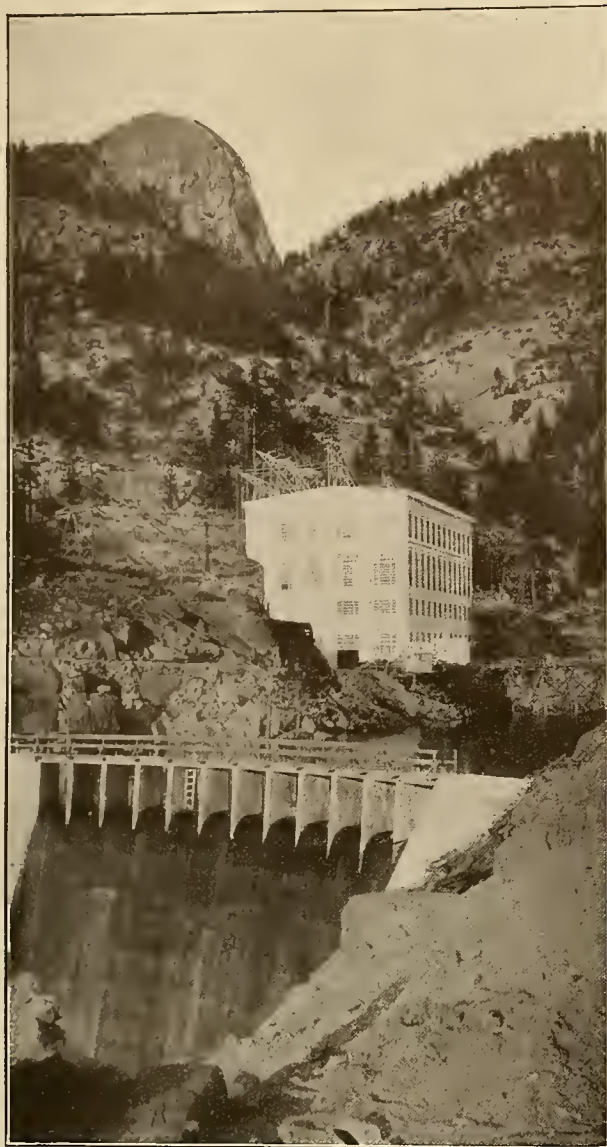
ivers with only pondage facilities and to make up the deficit from the storage in Lake Tapps, being careful however, to have all reservoirs full just before the peak comes on. Four steam plants are held in reserve to supplement the hydroelectric operation, but these have not been used for several years.

The Portland Railway, Light & Power Company also operates a typical system of this section in and about Portland, Oregon. All that has been said of

	Max. Head, Feet.	Minimum Head, Feet.	Effect of Variation in Head.	Generating Voltage.	Transmission Volts Out of Plant.	Rated Plant Capacity, 24-hr. kw.	Peak Plant Capacity, 1 hr., kw.	Sufficient Water to Operate Plant, Rated Load Throughout the year?	Is it Necessary to Draw on Storage to do This?	Pondage—Daily hrs. of Draw Out.	Pondage—Daily hrs. of Fill Up.	Steam Plant Type of Prime Mover.	Fuel.
Kern R. 1	865	865	None	2300	60000	20000	20000	No		5:00 p.m. to 9:00 a.m.	12:00 p.m. to 5:00 a.m.		
Mill Ck. 1	506	450	.....	2500	30000	750	750	No					
Mill Ck. 3	1825	1825	.....	750	30000	1200	1200	No					
S. Anna 1	715	700	.....	750	30000	3000	3000	No					
S. Anna 2	310	305	.....	750	30000	1200	1200	No					
					Long Beach	47000	47000					Turbine	Oil
					Los Ang. 3	10000	12000					Turbine	Oil
White Riv.	440	440	None	6600	55000	24000	30000	Yes	Yes	No Pondage	None		
Snoqual.	266	244	None	2000 & 6900	55000	19750	22000	No	None	5:00 a.m. to 10:00 p.m.	10:00 p.m. to 5:00 a.m.		
Electron	871	865	None	2300	55000	6040	22000	Yes	No	6:00 a.m. to 10:00 p.m.	10:00 p.m. to 6:00 a.m.		
				Georgetown	13800	13800	12000	13000				Vertical Turbine	Oil
				Post St.	2300	2300	3000	4000				Vertical Reciproc.	Coal
				Bond St.	2300	2300	1500	1500				Horiz. Trb. & Recipr.	Coal
				(550 d.c.)	(550 d.c.)								
				Nooksack Falls.		1500	....					
				York St. Purchased	2300	2300	3030	....				Horiz. Turbine	Coal
					60000	5000	....					
	435	420	None	11000	100000	50000	55000	Yes	Yes	Summer	Winter		
						10000	10000					Turbine	Oil
						16000	22000					Turbine	Oil
River Mill	81	70	None	11000	57100	9900	12375	No		5:00 p.m.	11:00 p.m.		
Ore. City	40	10	None	11000	11000	7230	8770	No		5:00 p.m.	11:00 p.m.		
				11000	57100								
Cazadero	132	110	None	2300	33000	14250	15500	No		5:00 p.m.	11:00 p.m.		
Bull Run	325	292	None	6600	57100	11250	11250	No		5:00 p.m.	11:00 p.m.		
					N. Portland	12500	12500					Trb. Vert. Rec.	Mill Waste and Oil
					E. Portland	6000	8000					Trb. Corliss	Ditto
					St. Johns	2500	3125					Turb.	Ditto
					Salem	1000	1000					Recip.	Ditto
Post Falls	45.92	45.92	None	2300	60000	11250	13500	No	Yes				
				4000									
				600									
Spokane	72	72	None	300	60000	8800	8600	No	None	3:00 to 11:00 p.m.	11:00 p.m. to 6:00 a.m.		
Little Falls	65	65	Yes	4000	60000	20500	23625	No	Yes				
San J. 1	1411	1411	None	2300	60000	16000	18000	No	Yes				
San J. 3	401	401	None	550	30000	2000	2500	No	Yes				
Tule	1463	1463	None	2300	60000	6000	7000	No					
Kern	211	211	None	500	10000	1350	1350	Yes					
					Bakersfield	16550	18600					Turbine	Oil & Gas
					Fresno	750	750					Recip.	Oil
					Santa Maria	200	250					Recip.	Oil
					San Luis Ob.	130	150					Recip.	Oil
	120	100	None	4400	60000	36000	50000	Yes	Yes				
No. 2	900	900	None	2200	55000	4800	6000	No					
No. 3	780	780	None	2200	55000	5800	7200	No					
No. 4	950	950	None	2200	55000	4800	6000	No					
No. 5	380	370	None	2200	55000	1500	1600	Yes					
No. 6	240	235	None	2200	55000	1800	2000	No					
S. S. P. Co.						3000	7000					Turbine	Oil

the Puget Sound people and country is true also of the Portland district, excepting that marine commerce is very limited and to the south agriculture is more extensive. The load has the same characteristics and about the same load-factor, possibly as low as 60 per cent. The company has four hydroelectric plants, River Mill and Cazadero on the Clackamas River, Oregon City on the Willamette, and Bull Run on the Big Sandy, feeding into its system of transmission lines

from the outskirts, and four steam stations, two of which operate during low water season to make up the deficit in peak kilowatts. There is no storage reservoir, but each plant has a pondage basin in which the flow is stored during the night. The load is distributed by a central load dispatcher and an effort is made to conserve water by loading the most efficient units first. It is interesting to note the Oregon City plant on the Willamette River, which was one of the



Pacific Light & Power Company's Big Creek Plant.

first hydroelectric developments in the West, and possibly the first to be synchronized with another alternating current generating station. It is equipped with vertical turbines, two on each generating unit, one a

42 in. runner for use when the head is high (up to 40 ft.) and the other a 72 in. runner for use with low heads down to 10 ft.

California Companies.

To describe here the system of any one company would not be representative and would be unfair to the twenty or more other corporations which operate about 76 plants in California, hence a few generalizations and references will be given. The average daily load factor is about 65 per cent, because the bulk of the business is in supplying people in the cities and miscellaneous manufacturing. Some of the systems run up as high as 75 to 80 per cent, as the Southern Sierras Power Company, which has considerable constant load in irrigation and mines. Other companies which are new in the field drop as low as 50 per cent, not having yet acquired any considerable 24 hour power business, and are retailing to the commercial trade. The Southern California Edison Company supplies energy to Los Angeles and vicinity from six water power and two steam stations and is the only one of the several companies mentioned that carries the entire system regulation on steam, while the hydro stations operate at or near unity load factor. The Big Creek plants of the Pacific Light & Power Corporation are interesting for the high heads utilized. Plant 1 draws water from the storage reservoir under 2009 ft. of head and discharges it in the forebay of Plant 2 on which the head is 1815 ft. The transmission is to Los Angeles and vicinity, 240 miles, at 150,000 volt pressure. This system also is supplied from four other hydro stations, Sierra, Mentone, Borel and Azusa and Redondo steam, making a total capacity of 120,000 kilowatts. The Pacific Gas & Electric Company serves in part the San Francisco district from eleven hydroelectric plants and four steam plants. None of the electric plants have any considerable storage facilities and steam is used continually to generate at the center of load, San Francisco. The highest head is at the de Sabla plant, 1531 ft. The Great Western Power Company also serves the San Francisco country from one hydroelectric plant at Big Bend on the Feather River, and two steam plants, Oakland and San Francisco.



Pacific Gas & Electric Company's Lake Spaulding Dam.

The head at Big Bend is 435 ft. and the reservoir holds 54 million kilowatt hours. In all the systems where pondage exists the most efficient units are loaded first and water is conserved during dry periods; but where the plants run on flow only, they are kept at as nearly 100 per cent load factor as possible and the regulation is taken on steam or storage plants. No effort is made to keep the plants nearest the "center of gravity" of the system loaded up since transmission losses do not exceed 20 per cent and average 15 per cent.

In concluding the foregoing descriptive narrative, we present the tabulation of data on leading Pacific Coast systems that has been referred to.

Summary.

Of all the estimated available power on the Pacific Coast, only 2 per cent is now developed, and of this amount available, California has 57.5 per cent, Oregon has 17.5 per cent and Washington 25 per cent.

At the present time there are but four developments that have any considerable storage reservoirs. This is because there has been much more power available than the market has demanded, and it has been more profitable to utilize the minimum flow of a number of rivers than to create storage facilities; and also, because before the advent of efficient high tension long distance transmission it was impracticable to build storage lakes of considerable size near the centers of loads. However, the increasing market, the decrease in available cheap water power sites, the growth of population, and refinements in generation and transmission have made it necessary and possible to build plants of sufficient storage capacity to operate continuously the year around, and such is the present tendency.

While in theory it is desirable to carry the most efficient units of a system fully loaded longest, there are so many local conditions at each place that this practice can be observed only as a general consideration.

The storage being limited in quantity, there has never been an opportunity to develop any general practice along this line, beyond taking care to drain the reservoir by the end of the dry season and thereby avoid having to generate that many kilowatt hours by steam.

The low load factor shown by most of the systems has brought up interesting considerations of the value of peak power and the relative cost of steam and hydroelectric generation to carry the short high peak load. It has been shown that with a 50 per cent daily load factor, 60 per cent of the capacity will generate 90 per cent of the kilowatt hours and that the peak requires 40 per cent of the capacity to generate only 10 per cent of the kilowatt hours.

The production of sulphuric acid, expressed in terms of 50 per cent acid, in the United States in 1915 was 3,868,152 short tons, valued at \$29,869,080 together with 189,795 short tons of oleum or fuming acid of different strengths, valued at \$2,787,971, making a total of 4,057,947 short tons, valued at \$32,657,051. These figures include so-called by-product acid produced at copper and zinc smelters. The production of acid from this source in 1915 was 1,056,830 short tons, expressed in terms of 50 per cent acid, valued at \$7,042,126.

FIRE PROTECTION OF ELECTRIC PLANTS.

BY M. E. CHENEY.

(Concluded.)

Typical Steam Power Plant.

Station is of brick 100 ft. by 100 ft., 25 ft. high. Walls are of brick 14 in. in thickness, strengthened by brick pilasters 26 in. by 18 in. spaced 14 ft. centers. Roof, joisted construction. Station divided into two sections of equal area by a 16 in. brick wall to roof only; wall has three unprotected communications of ordinary size. Section on north occupied by boiler plant; that on the south by generating and switching apparatus.

Referring to our schedule we find that a building having standard brick walls takes a basis rate of \$.58 per \$100 of insurance carried.

Investigating our station now for chargeable deficiencies we will note the following:

Basis	.....	.58
1. Partitions—These are of brick or tile and are standard.		
2. Parapets—Standard; all exterior walls rising well above the roof; no charge to be made.		
3. Roof—Composition on wood sheathing on wood trusses; charge	.....	.10
4. Unprotected metal—None.		
5. Skylights—None.		
6. Floors—Concrete; standard.		
7. Stairs and floor openings—Station one-story. Stairs to condenser pit only; no charge.		
8. Finish—Open; no concealed spaces.		
9. Exterior attachments—Frame ventilating monitor with plain glass in wood frame sides; charge .04 plus .02 for glazing	.....	.06
10. Area—10,000 sq. ft.—excess 2500 sq. ft. at .01 per 1,000	.....	.03
11. Height—One-story only; no charge.		
12. Lighting—Electric; incandescent. Wiring open and defective	.....	.05
13. Heating—Steam; standard.		
14. Fuel oil—None.		
15. Occupancy—Steam generating station only.		
16. Conductors—High tension conductors; 25,000 volts; arranged as in standard; no charge. Low tension conductors; 2300 volt; rubber covered, run on porcelain cleats and grouped in a common raceway in floor. Trouble in one conductor could readily extend to others; charge	.....	.05
All conductors equipped with proper protecting devices.		
17. Switchboard—12 panel; slate on metal frame; standard.		
18. Resistances—Of approved type but mounted on combustible supports; charge	.....	.05
19. Lightning arresters—All circuits equipped; arresters of electrolytic type mounted outside station; standard		
20. Transformers—Two 2000 kw., oil-filled, water cooled, mounted on floor of station; not enclosed as in standard; charge	.....	.03
21. Boilers—Of Stirling water tube type; standard brick settings. Boilers in section separated from generating section by 16 in. brick wall rising to roof only and having numerous unprotected openings; charge	.....	.10
22. Stack—Metal; passing through combustible roof with insufficient clearance; charge	.....	.10
23. Gas engines—None.		
24. Waste cans—None; charge	.....	.02
25. Lockers—All of wood; charge	.....	.02
26. Oils—Large quantity of lubricating and transil oil stored on station floor proper; charge	.....	.15
27. Watchman—Plant in continuous operation.		
Protection—Private.		
28. Sand pails and extinguishers—None; charge	.....	.05
29. Standpipes and Hose—None; charge	.....	.05
Protection—Public.		
30. Water supply—Adequate, and mains of approved type and adequate size; 8 in. main 100 ft. from station.		
31. Hydrants—Only one within 300 ft. of station; charge	.....	.02
32. Hydrants—Of standard type.		
33. Location of Fire Department—Within one-half mile; auto driven apparatus; no charge.		
34. Fire Department—Partially paid only; charge	.....	.02
Fire Department—Equipment adequate; no charge.		
38. Fire alarm—No box within 300 ft.; charge	.....	.02
39. Care and maintenance—Fair only. A number of packing cases and excelsior just outside of and against building; charge	.....	.10
40. Age and condition—Fair; no charge.		
41. Exposures—Frame fuel bin 25 ft. from boiler room. Shavings and refuse used for fuel. Fed to boilers by conveyor. Exposed wall of power plant has several unprotected openings. Exposure is graded as ordinary account of size and carries rate of \$2.00; absorbed charge being 16 per cent. Charge reduced by one-half account distance and by one-fifth account same ownership. Exposure charge 2.00 times .16 times .50 times .80	.....	.13
Building and general contents	.....	\$1.74

Electrical machinery and apparatus because of being more susceptible to damage from fire and water than other classes of apparatus and building, takes a higher rate than general contents and building. This differential is based on the nature of the building

and is 15 cents where floors or roofs are of combustible material and 7 cents where of non-combustible construction.

Electrical contents then in our plant carries a rate of 1.74 plus .15 or.....\$1.89

A further differential is made in the rates for the attachment to the policy of an 80 per cent co-insurance clause. This clause means that the assured must carry insurance equal to or in excess of 80 per cent of the value of the property insured. Fulfilling this requirement, the clause does not apply any more than if it were not on the policy. Only in the event of failing to fulfill this requirement, does the assured pay a penalty by becoming a co-insurer or an individual self-insurance company, insuring himself to the extent of such deficiency or shortage.

Establishing a rate under the consideration of a co-insurance clause is not only more satisfactory to underwriters but is more equitable to the assured, for such rate takes into consideration the relation of insurance to value.

In risks of the type and character of power plants and substations the average loss per fire is considerably less than total and that fact is given consideration in fixing the premium rate.

Without the co-insurance clause a certain property owner, relying on this relation of loss to value, may take the chance of carrying less insurance than the value of his property and consequently while he might lose but 50 per cent or so of this value, the underwriters insuring him would sustain a total loss—exhausting the policy while the loss to the property is only partial.

Insomuch as it is often difficult to determine the exact value of insurable property, it was decided to fix 80 per cent of insurance to value as a standard which is not too onerous for the assured and still gives the underwriters a good basis on which to compute rates.

For the attachment of an 80 per cent co-insurance clause then a reduction is made in the rates as given by schedule above of \$.50, giving:

Building and general contents.....	\$1.24
Electrical contents.....	1.39

Correction of Defects.

Now the protection engineer, in an effort to minimize the hazard in the plant, notes from a survey of the plant that there are a number of defects in construction and equipment contributing to the hazard which may be readily corrected. Let us glance at some of these:

12. Lighting—Very probably if the present installation were carefully overhauled it could at small expense be placed in a standard condition for open work. If this approved condition were attained then the charge of 5 cents made because of non-standard condition could be reduced to 1 cent—1 cent being the charge for open work in standard condition. This gives a credit for correcting this defect of \$.04.

16. Conductors—If these are relaid in standard manner charge for present condition may be omitted; credit .05.

18. Resistances—If these are standardly installed, that is, on metal supports, and isolated from all woodwork; charge of 5c for present condition may be omitted; credit .05.

22. Stack—If the iron stack be given ample clearance and ventilating hood properly installed; the charge of 10c for its present condition may be reduced to 2 cents; credit .08.

24. Waste cans—If a sufficient number of approved waste cans are installed, charge for their absence may be removed; credit .03.

25. Lockers—If standard metal lockers are installed in place of present wooden lockers charge may be omitted; credit .02.

26. Oils—If an oil house be constructed, say at least 50 ft. from the station and all oils except the permissible quantity removed from the station, charge of 15 cents for oil may be omitted; credit .15.

28. Internal protection—Since the area of our station is some 10,000 sq. ft., complying with the rule for number of sand

pails and chemical extinguishers, three of the former and one of the latter to each 4000 sq. ft., we would require eight sand pails and three chemical extinguishers, these to be distributed through the two sections of the building, preferably two of the extinguishers being in the generating section. With reference to the type of extinguisher, those of the acid and soda type are recommended in stations in part of combustible construction. The carbon tetrachloride extinguishers are, however, valuable for oil and electric fires. We therefore would recommend that a carbon tetrachloride extinguisher be substituted for one of the soda extinguishers in the generating section. All extinguishers should bear the underwriters' label. Soda extinguishers should be re-charged at least once yearly and should be provided with a tag on which is kept an accurate record of the charging dates. If sand pails and extinguishers are installed as recommended then the charge of 5 cents for their absence may be removed; credit .05.

29. Standpipes and hose—To extinguish or hold in check fires which have passed the incipient stage more water is necessary than can be furnished by pails or hand extinguishers. This condition is best met by interior standpipes and hose. Hydrants should be placed in each section and should be fed by not smaller than a 3 in. pipe. These should be located so that with not more than 75 ft. of hose on each any part of the station may be reached. In our station we would require probably to meet the best conditions—depending, however, upon the arrangement of the apparatus, two 1½ in. hydrants in each section. Hose should be of linen of an approved make not less than 1½ in. in diameter with ¾ in. nozzle and for our station in possibly 75 ft. lengths, hung on a rack. Hose to be attached to hydrants and have nozzle attached so that in event of fire no time will be lost in applying the stream. Hydrants should have an adequate supply of water at a pressure sufficient to throw streams over the highest point of buildings. Supply to be from city service where practical; otherwise from a standard 500 gallon per minute underwriters' pump available for immediate use or from an elevated tank of not less than 10,000 gallons. All pipe if exposed to be protected from freezing. For the installation of standpipes as proposed the charge of 5 cents for their absence may be removed; credit .05.

31. Hydrants—If one other standard city hydrant be installed on the 8 in. main within 300 ft. of the plant, the charge for but one hydrant may be removed; credit .02.

38. Fire alarm box—If a municipal fire alarm box be placed within 300 ft. of risk, charge of 2 cents for its absence may be removed; credit .02.

39. Care and maintenance—If all the unnecessary combustible material about the plant be dispensed with and the building and surrounding grounds be kept at all times in a neat and tidy condition, a charge of 10 cents for present condition may be removed; credit .10.

41. Exposures—Insomuch as the frame fuel bin in more than 20 ft. from power plant if the unprotected openings now in the exposed wall of the plant be protected by approved wired glass in metal frame, or by standard metal-clad or metal shutters then the exposure charge of 13 cents may be removed; credit .13.

The correction of the above defects results in a total credit of .79.

This means that our former rates will be in each case reduced by \$.79, giving the following:

	Old.	New.
Mode 1—80 per cent co-insurance clause:		
Building and general contents.....	\$1.24	\$.45
Electrical contents	1.39	.66
Mode 2—No co-insurance clause:		
Building and general contents.....	1.74	.95
Electrical contents	1.89	1.10

Comparing rates made before the remedial defects were corrected with those under the improved condition a reduction is shown of more than 50 per cent in the Mode 1 rates and of nearly 50 per cent in the Mode 2 rates.

Or from another angle, for every \$100 of insurance carried a saving of 79 cents in the premium is made. If our plant were insured for \$100,000 then the saving per annum would amount to \$790—10 per cent interest on \$7900—more than enough to correct the defects as outlined. Surely a proposition which should strongly appeal to the business judgment of each manager even if he were so blind as to overlook the real advantage to be gained—a plant practically immune from damage and a service proof against serious interruption by fire.

The deficiencies to which your attention has just been called are those readily corrected and do not in any sense conclude the list of chargeable defects. Further reductions may be made for a proper arrangement of transformers. If the brick wall between the boiler room and generator room were carried through the roof and the openings bricked up or protected by double standard automatic fire doors—then would not only the charge of 10 cents for boilers not apply to the generating room but the two buildings would be sep-

arately rated and other deficiency charges apply only to the section in which such deficiencies obtain.

Methods of Rate Reductions.

We hear continually that insurance rates are too high. Undoubtedly they are—yet based on the loss ratios, the rates are much lower in the United States than in Europe, notably Germany, which has an average loss of 12c per \$100 insurance carried as against 64c in the United States. This is not to be wondered at when it is remembered that more insurance premiums are collected in the United States per annum than in all the rest of the world combined. Commodities in quantities cost less per unit, so it is with insurance.

Quoting in part from an authority in matters pertaining to insurance—"There are just three directions in which insurance rates may be reduced.

1. By reducing the profits.
2. By reducing the expense.
3. By reducing the losses."

The average of $3\frac{1}{2}$ per cent residue from the premium income, from which small percentage must be extracted—profit and accumulation for the next conflagration—leaves the profit far too small and unreliable to tempt much new capital, particularly in the fact of past experience; and by the way, the values just quoted will from all indications have to be revised, for the report of the insurance commissioner of the state of Washington for the year 1915 disclosed the fact that from their underwriting business insurance companies operating in that state realized not a profit but on the contrary sustained a loss of 5.8 per cent. Out of 1400 or 1500 companies organized in the past 50 years, there have been over 1200 failures and retirements from lack of profits. Rate reduction in this direction then does not seem practicable.

With reference to a reduction in expenses—scientific methods of management are employed and the work is done with marvelous efficiency, with no more waste than in other businesses. Competition and the natural value of the service rendered have regulated the expenses of fire insurance the world over. They are about the same all over Europe, South America, Asia, Australia, United States and Canada. Surely if a reduction of expenses were possible, companies in some of these countries, at least, would endeavor to increase their profit by so reducing them.

There remains then the only one unquestioned way to reduce the rates. That one way will also automatically reduce the volume of expense and profit. The moment we reduce the fire loss in this country to the European standard, that moment will we get the European rate standard. When we have cut down our 64c loss on every \$100 insurance carried, to the German figure of 12c, we will get the German rate of $22\frac{1}{2}$ c. Not before, because it is a plain mathematical process, not a financial juggle.

In conclusion I want to state that The Washington Surveying and Rating Bureau under the State Insurance Code is public service in character and not only is it anxious to co-operate with you to reduce to a minimum losses from fire, but will also gladly furnish you with surveys or ratings of all properties under its jurisdiction in which you are interested.

FEASIBILITY OF ELECTROCHEMISTRY AT THE DALLES.

BY O. F. STAFFORD.

(Continued.)

Calcium Carbide.

The calcium carbide industry has had a most checkered career since its beginning in 1892. The wonderful properties of carbide led to an enthusiastic over-development of the industry which reached a crisis in 1899, since which time production has been restricted by selling agreements, as far as European manufacturers are concerned, and by a monopoly in both manufacture and sale in America.

The industry has been retarded by the rapid development of electric lighting, doubtless, and it now appears that electricity will replace acetylene even in the field of automobile lighting. An assured place seems to exist for acetylene in the metal-working industries, however, where it is finding an increased use in autogenous welding. Calcium carbide is also an intermediate product in the manufacture of calcium cyanamid, a substance through which atmospheric nitrogen is utilized for the production of nitrogen compounds useful in the fertilizer industry and in other fields of chemical manufacture. In this last use of carbide there seems to be an unlimited field for production. The matter will be considered at length in a later section of this report.

The raw materials for carbide are lime and carbon, the latter being necessary in the form of either low-ash coke, charcoal, or anthracite coal. The process of manufacture consists in heating the lime and carbon together to a temperature of about 4000 deg. F. when the carbide forms as a melted mass which, upon cooling, solidifies and may be broken up, sized, and packed into air-tight containers for shipment.

The world production of calcium carbide, for uses other than the making of calcium cyanamid, is about 300,000 tons, of which one-fourth is made in America by a single concern which controls the industry. The world production absorbs 180,000 horsepower-years of electrical energy.

Recent tariff legislation has placed carbide upon the free list for importation, but so powerful is the single carbide interest in this country that importations have so far been negligible. On the other hand, carbide has been exported from time to time and sold abroad in competition with that produced by the unusually cheap water-powers of Europe.

Distribution statistics are not available, owing in a measure to the monopoly existing in sales as well as in production. A probable assumption is that the distribution of carbide consumption is parallel to the distribution of population, which would make the consumption in the Pacific Coast territory not over 3000 tons per year at most. It is authoritatively stated that a factory to operate under the most economical conditions should make about eight times this quantity.

As nearly as can be estimated in the light of the unsatisfactory information available, it appears that carbide manufacture in the East in a plant making 25,000 tons per year could be carried on at a cost not exceeding \$35 per ton of product packed and ready

for shipment. This assumes the use of 16,000 horsepower-years of electrical energy at \$15; a capitalization of \$250,000 with an eight-year amortization period; interest 5 per cent; carbon \$6 per ton; coal \$3 per ton; lime \$5 per ton.

A parallel computation for western conditions gives a cost of \$38 per ton, assuming the cost of energy to be \$9 per horsepower-year; capitalization \$280,000; labor 115 per cent of that in the East; interest $5\frac{1}{2}$ per cent; carbon \$8 per ton; coal \$5 per ton; lime \$6 per ton. It is seen that this advance over the cost at an eastern locality must limit carbide production upon the Pacific Coast to that consumed locally. Were it possible to serve the carbide demands of all countries bordering upon the Pacific a plant producing 25,000 tons per year might be a possibility of the future, its success depending obviously upon the genius of the man in charge of its sales department.

Chlorates.

Although the manufacture of potassium chlorate in all probability never will consume large blocks of electric power in the sense that the aluminum or carbide industries are power consumers, yet the manufacture of this substance might bear an important relationship to the development of the Pacific Coast states because of its possible use in the making of cheap explosives.

Chlorate powders have in general been in disrepute owing to the fact that early attempts to make them resulted in disastrous premature explosions which for many years deterred further experimentation. Lately, however, it has been found possible to make and keep chlorate powders with as little risk as in the explosives industry generally so that their use is increasing. There would seem to be an extensive demand in the West for these powders in road-making and land-clearing if their cost relative to other explosives really works out to be less. With the use of mixtures of the rack-a-rock type, especially, a development in this direction is promising.

The extent of the demand for chlorate powders in the West is a problem which it is impossible to solve at present since there is the question of their ultimate superiority yet to demonstrate and in addition to this a long campaign of education among consumers before it may be expected that a new explosive may be substituted in practice for a familiar one. The chlorate powder industry must also expect to meet the competition of the very strong business concerns making other explosives. A local manufacturer of chlorate powder, however, asserts an immediate outlet for as much as 2000 tons of chlorate per year if it were available at a reasonable price, with an indefinitely increased consumption as the merits of chlorate powder would become known. A manufacturing unit capable of turning out 2000 tons of chlorate per year would be large enough, it may be said, to operate advantageously from an economic point of view.

The only raw material required for making potassium chlorate is potassium chloride, the "muriate of potash" of commerce. The sole present source is in Germany where production and sales are under the control of the well-known Kali Syndicate. The efforts made lately by the federal government to develop an independent domestic source of potassium

compounds are summarized elsewhere in this report under the discussion of raw materials.

Domestic consumption in the United States is entirely of domestic manufacture, several factories being in operation in the East and Middle West. Their production in 1909 was 12,000 tons. Sales are made under agreements, apparently through a single selling agency. The price in New York just prior to the outbreak of the war was \$140 per ton. Freight to coast points was \$23 per ton by rail. No rate upon this commodity via Panama seems to have been made as yet.

Exact cost data in the manufacture of chlorate under American conditions are not available. An estimate gives a figure near \$95 per ton as the probable cost under normal international conditions at an eastern factory site. The manufacture of a ton of chlorate requires something over one horsepower-year of electrical energy together with the equivalent of 1200 pounds of potassium chloride. This comparatively large power consumption per unit of product is favorable to the commercial success of a factory at a western site and undoubtedly all chlorate which could be consumed in the West could be manufactured advantageously here. Considering that the raw material potassium chloride should always be cheaper in the East than in the West owing to the shorter haul from Germany it does not appear that western-made chlorate can ever compete in the eastern market. Even the development of new sources of potassium compounds, as for example from western kelp, alunite or leucite, would be unlikely to affect this situation owing to the absolute power of price control possessed by the German syndicate.

The manufacture of sodium chlorate instead of potassium chlorate would do away with the dependence of the chlorate industry upon potash as raw material since common salt would be used instead. The substitution of the much cheaper sodium chloride should lead to substantial economies in manufacturing costs in spite of the fact that the technical difficulties to overcome are somewhat greater. Sodium chlorate is for many purposes not as desirable as the potassium compound owing to its tendency to absorb moisture. Very satisfactory explosive mixtures are made, however, in which the chlorate is protected against any possibility of moisture absorption by the nature of the other constituents. The logical development of the chlorate powder industry might therefore be in the direction of the use of the less expensive sodium chlorate.

(To be continued.)

PEP'S FAMILY TREE. BY THEO E. BURGER.

Progressiveness.	Energy.	Persistence.
Punctual.	Efficient.	Patient.
Resourceful.	Nimble.	Enduring.
Obliging.	Encouraging.	Retentive.
Generous.	Right.	Sensible.
Reliable.	Genial.	Impartial.
Exact.	Youthful.	Self-possessed.
Self-confident.		Truthful.
Sedate.		Entertaining.
Industrious.		Naive.
Vigilant.		Consistent.
Enthusiastic.		Yearning.
Noble.		
Eager.		
Sagacious.		
Systematic.		

SALIENT FEATURES OF N. E. L. A. PAPERS.

The following abstracts of advance copies of papers presented at the Chicago convention of the National Electric Light Association, May 23-26, 1916, have been especially prepared with Pacific Coast interests in mind:

The progress report by Secretary T. C. Martin shows that in the United States in 1912 the total investment in electrical properties was eight million dollars, representing 4.3 per cent of the total wealth of the nation. The capacity of central stations is increasing rapidly, but their number is decreasing gradually, owing to centralization. The earnings for 1915 was \$360,000,000 an increase of \$24,000,000 over 1914. The output was 18,400,000,000 kw.-hr., an increase of 1,800,000,000 kw.-hr. The annual per capita central station consumption in New England is 200 kw. hr., in the Middle West 500 kw.-hr. and on the Pacific Coast 500 to 740 kw.-hr. Foreign progress has been much less than American. Comprehensive summary is given of notable developments in technical, commercial and legislative matters during the past year in Mr. Martin's admirable style.

Technical and Hydroelectric Sections.

The meter committee report tells of an annual addendum to keep the Electrical Metermen's Handbook up-to-date. A lecture on meters has been prepared for section meetings. Instrument transformers are completely discussed as regards standardization of design and methods of testing. Portable batteries are recommended as a source of current for meter tests. Recent developments described include the following: A deflection potentiometer giving rapid readings to .001 volt; type CS-3 watt-hour meter, a cheaper form of type CS double armature astatic switchboard meter because the magnet shield is omitted, an improved form of Type P demand meter, and type E 6 potential transformer, all manufactured by the General Electric Company. Westinghouse new products described include type "OA" prepayment attachment for making a cheap prepayment meter from a standard service meter, type "RA" recording demand watt-hour meter, an outdoor metering equipment set for three-phase circuits up to 66,000 volts; a switchboard potentiometer for measuring temperatures of apparatus distributed about a plant; d.c. indicating instruments for heavy power circuits, and a portable cycle-counter specifically intended to indicate the number of cycles required for a protective relay to close its contacts and for any other timing purpose where intervals are too short to be observed with a stop watch. Duncan developments include their model M-2 a.c. watt-hour meter, M 2P polyphase watt-hour meter and a new line of current and voltage transformers. Weston new developments are the "potential transformer comparator voltmeter," designed to quickly and accurately compare the ratios of two potential transformers, and a new double-range ohmmeter operated on dry cells without rheostat and giving direct reading of unknown resistance in ohms. The Eastern Specialty Company has brought out a complete line of test-blocks, test-switches and test devices providing means for cutting out meters, short circuiting current transformers and obtaining testing current without disturbing the wiring or permanent connections. The Sangamo Economy railway meter is specially designed for severe use.

Electrical Measurements, Values and Terminology Committee recommends the abandonment of the horizontal candlepower and the adoption of the total emitted lumens as the universal basis of the output rating of illuminants. It recommends that all publications of the association be edited in exact accord with the terminology reports already submitted and approved. It recommends that all references in the publications of the Association to English units of measure be followed by their metric equivalents in parenthesis. The committee also submits a list of names and abbreviations and guides for style in text tables.

Lightning protection for transformers on 4000 volt distributing circuits is the subject of a paper by D. W. Roper, wherein it is shown that interruptions to service may be lessened by using transformers having their primary terminal boards either removed or submerged, and by installing arresters on transformer poles instead of line poles, thus eliminating about 90 per cent of the trouble former experienced in Chicago.

Underground construction for a. c. distribution has been hampered by a lack of dependable high voltage primary fuses and junction boxes. These difficulties have been partly helped by immersing fuses in oil and damping the explosion of a blowing fuse by means of an air cushion trapped in a horizontal tube mounted in the center of the fuse holder. Manhole oil fuses and junction boxes are used to disconnect cable sections. Operation of transformers in multiple has also helped. Cheaper construction is possible by using one service box to supply an entire block or group of customers. Stone conduit made of concrete localizes burn-outs. Manholes have been built in quicksand by a modified open caisson type of construction at about double the labor cost. Cables are carried under rivers by tunnels. In pulling cables, power trucks equipped with lighting storage batteries are recommended. Time can be saved in making repairs by using Conducell cable joint insulators. A new type of joint employing a metal sleeve and made under vacuum is in successful operation. Unit packages for cable joint material is recommended. The Knopp d.c. line testing set for measuring single conductor cable without opening the circuit is described. Account is given of a new method of trouble hunting employing an interrupter for the development of signaling current for finding faults. It is suggested that investigation be made of the current carrying capacity of cables. Moisture troubles are believed to be due either to the joints or faulty sheaths. Outdoor potheads for pole connections are suggested for the insulated conductor of underground cable to overhead wires. The cost of manhole cleaning can be reduced by using large dump wagons and a small gang of men. Various systems of tagging and numbering cables are described. Several methods of cooling hot duct lines, driving gas from manholes and pumping out water are suggested.

Overhead lines and inductive interference investigations have been confined to exhaustive studies of the proposed National Electrical Safety Code of the U. S. Bureau of Standards and the famous Order No. 39 of the California Railroad Commission. The Safety Code, while it will undoubtedly tend to eliminate improper construction, embodies in its present preliminary form material increases over present practice and its possible influence in increasing construction costs and hindering development is viewed with apprehension. "The fact that the (inductive interference) order, nearly two years after its issuance, has been practically unenforced is an interesting commentary either upon the need for such provisions or upon their feasibility. There has, however, been little new construction during the past two years, and there may be considerable change in the situation when the power companies start to carry out general extensions." Ground return telephone lines are not good practice and power companies cannot be properly held liable for interference to telephone lines so constructed. Increase in construction cost will seriously restrict the future building of minor distribution lines and hence the serving of small and scattered loads.

Prime movers of special interest are the tremendous steam turbine ordered during the past year ranging as high as 50,000 kilovolt-amperes for a Curtiss turbine to be installed by the Detroit Edison Company and 60,000 kilowatts in a Westinghouse turbine for the Interborough Rapid Transit Company of New York City. Condenser development has kept pace with the turbines. The advantages of sand-blasting

of condenser tubes are detailed. A more rational method of rating boilers is advocated. Standard boilers of 350 lb. working pressure with 250 degrees fahr. superheat are being made. Considerable attention is given the fusion temperature of ash and its effect on the commercial use of coal as well as to various types of mechanical stokers. Water power developments have been notable for their scarcity, due to financial conditions and decreased cost of steam-electric power. Many data are given regarding the reliability of hydraulic prime movers and the principal sources of trouble. A standard method of determining the head on wheels under test is needed. The large gas engine continues to lose ground as a prime mover for central stations. The Diesel engine situation is analyzed.

Electrical apparatus is being rapidly standardized. Recommendations are presented regarding standardization of transformer sizes, voltages and taps. The uniform rules on service requirements for motors are giving marked satisfaction. The capacities of single generating units have increased more than three-fold during the past five years, the largest to date being 60,000 k.v.a. Suggestions are given for minimizing noise in substations. Outdoor switch houses and metering equipment are briefly discussed, as are also synchronous converters and the phase converter for giving single phase service from three-phase systems. A harmonic analyzer is illustrated and described and also a cycle recorder. Several novelties in lightning arresters are mentioned and safety appliances for switchboards described. An outline is given of various street lighting systems.

Central station power for railways and general uses is advocated as an economic necessity of the future in a paper by Fred Darlington, argument being made for increased centralization of power service.

Accounting Section.

Annual report forms for electric light and power companies as required by all federal and state regulating bodies as exhaustively and completely compared show wide differences and inconsistencies. Companies are put to much needless expense in furnishing information of little or no value. The committee suggests simplification and standardization and aims to submit for association approval a concise, concrete and standard form of annual report to be recommended to all public service commissions having control over electric utilities.

Purchasing and storeroom accounting procedure of the Edison companies at Brooklyn, Detroit, Chicago and Boston are used to illustrate principles recommended by the committee. These include the suggestion that emergency orders be paid for from petty cash; that all buying be centralized in a purchasing department, which should keep an invoice register, file requisitions and price lists, direct inventory taking and sell scrap, and that a committee consisting of the purchasing agent, general sales agent and one other pass upon all appliances intended for re-sale.

Customers records as kept by 600 companies are compiled and classified as to methods of obtaining meter reading information, preparation and handling of bills and ledger information. The use of adding typewriters in billing and ledger posting is illustrated. There are upwards of 5,800,000 electric lighting consumers in the United States and this means about 70,000,000 bills per annum.

Company section difficulties were discussed in a report presented to the general session and in several supplementary papers. The apathy in local organizations threatens further growth of Class B membership unless methods are improved. Some sections have suffered from lack of company support, members have been coerced into joining, the national dues are claimed to be too high in proportion to benefits received, the Question Box is of limited interest and specialized handbooks are wanted rather than convention proceed-

ings. The committee recommends greater support from member companies and an extension of the handbook idea to involve the issuance of 20 to 25 specialized texts instead of bound volumes of proceedings. Control of various employees' activities should be centralized in the company section and mentioned in a company bulletin.

Geographic sections affiliated with the national organization are recommended as desirable in the several parts of the nation, membership being extended to include public utility companies and employees other than central stations. It is suggested that interest be stimulated by sending to the national convention two members from each company who have contributed most during the year to the section's advancement; that section papers be printed at association headquarters, that mailing be centralized likewise; and that section reports be standardized.

Commercial Section.

The annual report of Chairman Becker reviews the activities of the various standing and operating committees and presents a number of valuable suggestions. Of the Christmas book 250,000 copies were sold, an increase of 100,000 copies over the year previous. This "Handbook" has been entirely revised and is now ready for distribution. Over 1000 students are now enrolled in the salesmanship course. The wiring committee is reporting on a standard plug for the socket end of cords and the standardization of concentric wiring and fittings. The suggestion is made that the Power Sales Bureau be known as the Technical Committee of the commercial section, but that its work should in no way conflict with the work of the Technical Section. The newly-formed Lighting Sales Bureau has amply justified its existence as shown by a splendid series of papers containing material of value to the lighting salesman. The suggestion is made to co-operate with the national electric piano manufacturers in the solution of minor electrical details and the marketing of their product. The extensive report of the Range Committee, which forms an important addition to the report presented at the Northwestern Convention is enthusiastically referred to by the chairman, as is also the report of the Committee on Industrial Heating.

The finance report gives ample proof that the commercial section is on a self-supporting basis, having a surplus for the year 1915 of \$4953.05. The revenue derived from the sale of publications amounted to \$15,239.81 versus \$12,097.71 in 1914.

The Membership Committee reports 851 new members of the association. Many new members for the technical and accounting sections were also obtained. The suggestion is made that the new membership committee consist of a chairman and vice-chairman from each section, making it unnecessary for each section to have its own committee.

Publications were purchased by 300 member companies, an increase of 13 per cent over the number reported last year. The Christmas booklet had to go through three editions and of the Northwestern range report, in response to an insistent demand, 10,000 copies were distributed. Nearly 500 copies of the Merchandizing Report, 723 copies of Cushing's Manual and 137,817 copies of the booklet issued by the Society for Electrical Development on house wiring were sold to and distributed among the members; 110 new subscribers to the magazine "Rate Research" were secured. The committee has on hand for data for a booklet on "Better Industrial Lighting" and a publication entitled "One Thousand Uses of Electricity." The suggestion is made to publish a pamphlet on Electric Heating and Cooking, containing data which have been subjected to close scrutiny and can be vouched for as to their reliability.

The Handbook Committee reported the publication of the third edition of the Handbook. The most radical change over previous editions is a new and comprehensive index.

Under the new system additions and subtractions may be readily made, retaining the useful matter without confusion or repaging. The index is based on the numerical system, with divisions of classes of industries to which the applications apply. The master index now has over 1200 separate divisions representing kinds of industries or installations. The system was presented by Norman Macbeth. Considerable new material has been added to the lighting section on reflectors, calculation and design, exterior lighting of buildings, etc. The entire electric vehicle section has been revised and much new and valuable data on operating costs are presented. All new members of the section receive in addition to the Handbook, a desk file as well as pocket binder for use by the salesman. Sections are merchandising, ice-making and furnaces are now being compiled. The Handbook contains 800 pages, an edition of 6000 copies was ordered.

Education of Salesmen has been confined to introducing and conducting the course in Commercial Engineering. A prospectus of the course is presented. It comprises 8 lessons of Selling, 6 on Lighting, and 3 on Power. It obviates the necessity for special educational departments in most of the member companies; 1035 members are now on the roll. Company classes are organized, meeting under the guidance of a leader. An arrangement has been perfected with the Chicago Central Station Institute by which it conducts and compiles the course, which obviates the necessity of an expensive organization. Illinois leads in the number of students, the total being 167, followed closely by California with an enrollment of 156, while the cash price of the course is \$12, most of the companies are advancing this amount and having it returned by the student at the rate of \$2 per month. The committee outlines a course in magnetism and electricity, appliances, illumination, industrial heating, electric power and commercial management and suggests the addition of special courses in any branch of the business for which there appears to be sufficient demand.

The Way to Make a Salesman, by Earl E. Whitehorne, is summed up in the words "Get Right With Your Own Job." The central station salesman is lucky at the start, climbing aboard a vehicle that's on the way to opportunity. Let him feel that he is in business for himself. Let him take the attitude that here in this great growing industry is opportunity enough for him and let him make the manly boast within himself that he is man enough to grow great with this opportunity, to be a big success in this, his business. The author expounds ten concrete rules of conduct, a sort of central station salesman's decalogue. They may be summarized as follows: (1) To make a good impression on every person he meets. He will then not be forced to battle against prejudice. (2) Know enough about your company and the industry to inspire confidence. (3) Meet and know as many people of all classes as you can. (4) Be resourceful and prepared to offer more than just an argument. (5) Win the order now—poor salesmen call again. (6) Be strong in confidence and willing to take responsibility. (7) Create opportunity by creating new markets for yourself. (8) Educate and maintain friendly contact with your customers, for they are your most precious asset. (9) Co-operate with the electrical fraternity in your town and recognize their functions in the field you work in. (10) Co-operate. Fight hard in competition with your friends and with the records of your own achievements in past months and years. "We see all about us," says Mr. Whitehorne, "that the central station business man is assuming broader functions, rendering a greater service and is steadily becoming more and more the dominant force."

The Merchandising report states that the Hoskins wire patent situation is being adjusted in such a manner as to protect the interests of all parties concerned. The hope is expressed that progress will be made during the year in the attempt to standardize the connectors at the appliance ends of connecting cords. Under the caption "New Developments,"

R. D. Cutler discusses the increasing demand for development in domestic ranges, branding irons, washing machines for set tubs, dish washers, household refrigerating outfits, brooders, radiators, circulating water heaters, hand driers, etc. He states that there is still a sharp difference of opinion as to the relative merits of the radiant and non-radiant forms of heating units for ranges. A lamp socket, portable range for apartment house use has been one of the developments during the year. A machine that would cool air to a degree representing the consumption of fifty pounds of ice per day would, if it could be sold at a cost not to exceed \$50, find a demand even greater than the demand for ranges. It is recommended that a sub-committee be appointed to make a study of therapeutic electric devices which are rapidly increasing in number.

"Standardization" is treated by J. V. Guilfoyle, who hopefully refers to the standardization of both devices at the ends of connecting cords. Copper finished and brass hollow ware appliances are disapproved by the committee. Standardization of wattages of appliances intended for similar functions is recommended as well as efficient packing cartons for appliances.

"Industrial Appliances" by C. N. Lewis suggests that the salesman or solicitor should first decide whether a scheme is feasible. He amplifies this principle by the following examples, which are discussed at length: (1) The impracticability of heating buildings unless current is sold cheaply. (2) Heating of bathrooms should not be considered impracticable. (3) Describe in full the nature of the work to be accomplished. (4) Learn why the customer wants to use electric heat. (5) Get a photograph, cut or sketch of machine or parts to be heated. (6) Describe the operation of the machine in detail, stating the class of work. (7) The amount of material per charge. (8) Maximum time for heating up. (9) Accurate temperatures must be given. (10) Rate of production per hour is important. (11) If water is to be evaporated from material, get the percentage and samples of the material. (12) If insulated, get nature and thickness of insulating material. (13) If there is ventilation give size of openings. (14) Give dimensions of oven box or receptacle, inside and outside, and if liquid, how deep. (15) Ascertain space available for heater. (16) State voltage and kind of current. (17) Ask if heater is subject to vibration. It is important also that all commercial apparatus be properly installed, with proper wiring, etc., and a periodical inspection of its operation should be made. The salesman should obtain his data on a filing card and a record be kept of all installations. A form of filing card is submitted embodying spaces for the answering of the 17 questions mentioned above.

"Incandescent Lamps," by Miss N. Nevins, strongly urges the establishment of a lamp maintenance service. There is, a "watt-hour" element in the merchandising value of every lamp sold which is above and in addition to the part it pays in making up the sum of kilowatts connected.

"Ranges" are discussed by W. G. Stetson from a merchandising viewpoint. He touches on the rate question to the extent of mentioning the fact that electric cooking cannot be economically performed at a rate exceeding five cents. There is a demand for certain makes of electric ranges exceeding the supply and one maker reports that his entire 1916 output of 20,000 ranges will soon be sold. Ranges, he believes, will be sold in the following order: (1) For the kitchenette apartment. (2) The housekeeping apartment. (3) The detached house of moderate construction. (4) The country residence. (5) The city residence. The kitchenette range should sell for about \$25 and will then compete with a \$10 or \$15 gas range. Electric manufacturers are rapidly developing an improved line of electric fittings for range installations. Central stations are warned against following

(Concluded on page 421.)

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Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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The San Joaquin Light & Power Corporation is so appreciative of the California Railroad Commission's fairness in reducing their rates that it has filed a petition for a writ of review with the Supreme Court, alleging that the commission acted in excess of jurisdiction.

One result of the San Francisco Board of Supervisors' respect for the jitney vote is that each supervisor faces suit for \$50,000 and the city for \$140,000 because of a jitney murder, though palliatively called an automobile accident. Furthermore, Market street property owners are about to apply for a twenty-five per cent reduction in taxes because of jitney damage to business along this thoroughfare.

The West has been pre-eminently the pioneer in things electrical, whether technical or commercial. This role has been one of necessity, not of choice. Western men were pioneers in building higher-head hydroelectric plants, longer-distance transmission lines and cheaper distribution methods, just as they have been leaders in lowering rates and developing commercial loads, simply because they had to, and because they possessed the indomitable spirit and the indefatigable energy to meet the categorical imperative.

If they must, then they will.

After having applied untried methods to overcome unprecedented conditions, their results are now being investigated and adapted to adoption into standard practice. In this adaptive process there is a tendency on the part of those who do not appreciate pioneer conditions to criticize pioneer methods, to impose certain limitations on bolder expedients employed in sparsely settled territory, and to cause the pioneer to think that his has been a thankless task.

A pioneer, unlike a prophet, seems without honor, save in his own country. If poets are prophets, then engineers are pioneers. This is indicated by the fact that in proportion to population there are many more members of the American Society of Civil Engineers, American Institute of Mining Engineers and American Institute of Electrical Engineers on this Western forefront than elsewhere in the country. The pioneer engineer on the frontier is modest and unassuming. He works for the love of it without thought of reward. He deserves tribute.

The pioneer has risen above his humble origin as a peon directly as service has been exalted as the ideal of human attainment. Literally one who serves, he has ever gone before to prepare the way for others.

He is the forerunner of progress, for whose highways his footsteps were the first surveys. He dared the desert and made it blossom with the rose, he mounted the mountains and wrested their treasures of metal, he swam the streams and harnessed their turbulence.

He is the courier of civilization, overriding precedent and ridding of the impossible by doing it. He plays the game at the outposts of empire and enjoys the playing, slave of the wonder-lust but master of nature-dust.

He is the soldier of fortune, always marching in

advance, clearing the obstructions, mending the roads and building the bridges. Restless, tireless and restless, he maps the land and charts the sea, ever fighting against barbarism and retrogression—the military engineer.

He is the ambassador of evolution, the leader in science and industry and the benefactor of his race. Onward and upward is his course, ever willing to lend a hand, to start new things and to mend the old,—the civilian engineer.

His deeds honor his name if men do not. His fame lies in the future, when he will have annihilated time and space by utilizing the infinite force that rules the universe. Hail!

Among technical matters discussed at the Chicago convention of the National Electric Light Association this week none is of more vital interest to Western central stations than the report of the committee on overhead lines and inductive interference. This report mirrors the past year's developments in public regulation of line construction, especially as regards the national electrical safety code of the Bureau of Standards and the inductive interference order of the California Railroad Commission.

The proposed safety code has been the subject of numerous conferences all over the country. The Bureau has accorded engineers of the various interests affected every opportunity for discussion, thus bringing into co-operation and harmony widely divergent views. The final draft will be issued soon after a general conference on May 29th and 30th at Chicago. Then, for one year, the code will be submitted to the acid test of experience, when its rules for the safe construction, maintenance and operation of electrical stations, lines and equipment will be enforced by various regulating bodies.

The good effect of the code will be to make electricity safer in use by restricting inadequate construction and improper operating methods. Its bad effect, as apprehended by power engineers, will be to prohibitively increase the cost of distributing systems, or at least make necessary a raise in rates.

The same conclusions apply as regards rigid enforcement of the inductive interference order of the California Railroad Commission, which will probably be the guide for many similar orders unless sufficient funds are provided for the Bureau of Standards to conduct a far more searching investigation. However, it is to be noted that the telephone companies, having secured needed protection, are not likely to insist upon compliance with the more burdensome requirements. Telephone men realize that the growth of a district, and consequently an increase in telephone consumers is accelerated by the availability of cheap electric power, which in turn is largely dependent upon cheap construction of distributing lines.

The safety code and the inductive interference order are alike in representing a compromise between cheapness and safety. If future profits are not to be compromised an inverse compromise must be brought about between safety and rates. "Safety First" is a good thing, yet it costs money.

Just as non-interference with the satisfactory operation of telephone lines from inductive power lines

requires balanced circuits to neutralize electromagnetic and electrostatic induction, so there is necessary a delicate balance between costs and rates. The balance wheel to bring about these adjustments and to establish equilibrium is the public service commission in each state. The power man will welcome these rules safeguarding electricity and protecting against inductive disturbances if he can be assured that the commissions' policy will likewise be to safeguard electrical investments and protect against financial disturbances.

So our candid advice is for electrical men in the West not to chafe under these white-collar safety requirements of the wise men in the East. Trust in the wisdom of the body which may have to enforce the regulation and prepare the facts to prove that safety first like perfect service is merely a matter of rates allowed.

The one commercial section report of the National Electric Light Association of peculiar interest to the West is that of the electric range committee, all members of which are Western men. The report is of such local value as to justify

Cooking by Wire

future publication in these columns. It is based on the firm ground that electric cooking is an assured success in the West. From the housewife's standpoint it is practical, and from the central station standpoint it is desirable. The four problems awaiting final solution are advertising, merchandizing, rates and water heating.

As regards the first two, the committee makes plain the fact that aggressive efforts must be made by the manufacturers, particularly as regards educational work and guarantees. Excellent suggestions are made in this regard, most of them being along lines heretofore advocated in these columns. Nearly five thousand ranges were in use on Western circuits at the end of 1915, and the number will probably be doubled this year. Most of these have been sold and installed by the central stations at cost.

The committee does not recommend any definite form of rate for general use, but shows that a three-cent rate is sufficient to attract most consumers. Experience has shown that an average family requires one hundred kilowatt hours monthly, thus giving a cost of about three dollars a month.

Electric heating of water is still a stumbling block in many localities. Rates, as well as apparatus, are largely experimental. Some form of electric water heating is desirable wherever electric cooking is being enjoyed. As instantaneous heaters cause a prohibitive peak, the consensus of opinion favors storage of heat imparted at times of slight demand for current. Water, on account of its high specific heat, has a greater thermal storage capacity than any other liquid or solid. In continuous service one kilowatt will raise approximately one hundred gallons of water one hundred degrees, Fahrenheit, in twenty-four hours. With proper insulation the heat loss is not serious.

Summarizing the committee's list of advantages, electric cooking is found to be dainty, economical and efficient, clean, certain, cool and controllable, appetizing, perfect and progressive, moderate, safe and sanitary. Surely any other fuel decamps the field when the initial letters of these several qualities are so significant.

PERSONALS

B. J. Klein, Pacific Coast manager of the Bristol Company, is at Portland.

S. B. Gregory, Pacific Coast manager of the Arrow Electric Company, is at Los Angeles.

Paul F. Steck will handle electrical lines for the Bailey Drake Company of San Francisco.

C. E. Nestor, Pacific Coast manager of the Wallace Novelty Company, is in the Northwest.

N. Abrams, manager of the Western Agencies Company of San Francisco, is at Los Angeles.

F. J. Cram, sales manager Electric Appliance Company, has returned to San Francisco from Seattle.

H. E. Sanderson, Pacific Coast representative of the Bryant Electric Company, is in the Northwest.

H. S. Yost, assistant Pacific Coast manager Trumbull Electric Manufacturing Company is at San Diego.

T. A. Von Bebbler, electrical dealer of Petaluma, was in San Francisco for a few days on a business trip.

Julian Rowe, Chicago manager of the Crocker-Wheeler Company, spent a few days in San Francisco last week.

S. B. Clarke, superintendent of the Merchants' Central Heating Company of Spokane, has returned from Portland.

C. A. Sanborn, salesman for the Los Angeles branch of the Western Electric Company, was in San Francisco last week.

W. Brewster Hall, Pacific Coast manager Pass & Seymour, Inc., is making a month's trip through the Pacific Northwest.

O. W. Lane, formerly with Holabird-Reynolds Co., who was taken sick about six months ago, is convalescing at Los Gatos.

D. A. Wagner, manager Electric Agencies Company, has returned to San Francisco from a trip through San Benito and Santa Clara counties.

A. H. Noyes, salesman Electric Appliance Company has returned to San Francisco from a two weeks' trip throughout the Northern California territory.

J. E. Davidson, vice-president of the Pacific Power & Light Company of Portland, is attending the convention of the National Electric Light Association at Chicago.

H. W. Hoxie, sales manager of the Electric Railway & Manufacturers' Supply Company, left on May 17th for a trip to Nevada. He will make the entire state on this trip.

Samuel H. Taylor, president of the Electric Railway & Manufacturers' Supply Company, returned May 17th from a trip to the Causeway Celebration at Sacramento and a business trip to Stockton.

W. Popper, Interstate Electric Novelty Company, at San Francisco, has been attending the Pure Food Show at Ukiah and speaks in the highest terms of the displays being made by the different electrical houses.

F. W. Wood, Pacific Coast agent for the Gamewell Fire Alarm System, has returned to San Francisco from a trip through Nevada, Idaho, Utah, Oregon and Washington, while A. F. Brown, of the same company, has returned from a two weeks' trip through California.

Paul McKee, assistant to the president of the California Oregon Power Company of San Francisco, in company with Wm. M. Sheppard, commercial agent have completed a two weeks' inspection tour of the Trinity Center line in Northern California and report the work progressing rapidly.

W. P. Naser, Pacific Coast manager of the Trumbull Electric Manufacturing Company, has been promoted to take charge of the company's entire business west of Pittsburg. He is leaving for the East shortly and will probably spend

several months there before visiting the coast again. H. F. Yost, assistant manager, will have charge of the San Francisco office during Mr. Nasser's absence.

A. R. Loughborough, who, for the past three years has been manager of the Salt Lake office of the Western Electric Company, has been promoted to the position of sales manager of the Cincinnati office of the same company and has assumed his new duties. Mr. Loughborough entered the service of the Western Electric Company thirteen years ago as stock clerk. In the comparatively short time which he spent in Salt Lake City he made a host of friends who were pleased to learn of his good fortune. D. J. Butts has been assigned to the managership of the Salt Lake office. Mr. Butts has been in Salt Lake City for the past three months. Prior to that he was in the Boston office of the Western Electric Company for five years, and he has been in the service of the Company for fourteen years.

MEETING NOTICES.

Portland Sections of A. I. E. E. and N. E. L. A.

The joint luncheon club of the Portland sections of the A. I. E. E. and the N. E. L. A. of Portland, Oregon, has discontinued its bi-monthly luncheons indefinitely.

San Francisco Electrical Development and Jovian League.

On May 17th, with T. W. Simpson of the Federal Sign System (Electric), as chairman of the day, the league enjoyed an interesting address by Judge Frank J. Murasky as to how the youth of today is being made a better man of tomorrow. He explained the purposes and procedure of the juvenile court and told of some of the results accomplished.

Los Angeles Jovian Electric League.

Ira J. Francis, manager of the local office of the John A. Roeblings' Sons Company, was chairman of the day at the luncheon given on May 17th, and furnished a good program. The meeting was "in the hands of the law" so to speak, the principal speakers being Oscar C. Mueller, a prominent local attorney, and Albert H. Elliott of San Francisco, who needs no introduction. "What is the Matter With the Law?" was the title of Mr. Mueller's address. He stated that the greatest difficulty that the lawyer had to contend with is the multiplicity of conflicting laws of the different states, and he also criticised our cumbersome methods of handling legal cases. He said that in the past fifteen years in this state, 17,000 bills were introduced, 5000 of which have become laws. The 1915 legislature alone, introduced 1900 bills, 771 of which passed. He praised the constructive work of the American Bar Association, and in closing made a plea for uniformity of legislation; not more law, but more uniform law. He was followed by Mr. Elliott, who gave a stirring address on the subject of "Co-operation."

Engineers' Corps of California.

One hundred and sixty engineers met at lunch at the Engineers' Club, San Francisco, May 20th, to learn of object, policy and membership of the Engineers' Corps of California. As briefly reviewed by Jos. D. Smedberg, its organizer, the body already has a membership of 271 engineers in various units throughout the state.

Captain Richard Park, Corps of Engineers, U. S. A., outlined the study and drill schedule to be followed by the organization during the next two years. The first year's course has three departments, military art, military engineering and other arms. The department of military art has two study schedules: (A) organization, administration, equipment, duties and training, (B) psychology of war, conduct of war, military history, military policy of the United States, and the functions of other arms. Schedule A has eleven subdivisions: map-making, field fortifications, reconnaissance, sieges, demolitions, battlefield illumination, communications,

general construction work and special services, castrametation, and seacoast fortifications. This schedule is to be completed by September 1, 1916, after which further details will be announced later.

Brigadier General W. L. Sibert gave his approval to the spirit of the organization, told of the duties of an engineer in the field and illustrated his point with an account of overcoming obstacles in the Philippine campaign. Lieut.-Colonel Thomas H. Rees, Corps of Engineers, spoke on the relation of the Engineer Corps of California to the Engineer Corps and other technical branches of the army. H. W. Crozier presided as chairman at the enthusiastic meeting.

EXAMINATION FOR JUNIOR ELECTRICAL ENGINEER.

The U. S. Civil Service Commission announces an examination for junior electrical engineer, for men only, on June 21, 1916, to fill vacancies in the Bureau of Mines, Pittsburgh, Pa., at salaries ranging from \$960 to \$1200 a year. The duties of this position will be to conduct experiments with electrical machines, lamps and other apparatus for the purpose of increasing the safety and efficiency of mining operations. The duties will include the design and construction of testing equipment and devices, under direction, the determination of the proper conditions for test, the making of observations, the recording of results, and the preparation of reports. Competitors will be examined in practical questions in electrical engineering (40), education and experience (60). Graduation from a four years' course in electrical engineering from a college or university of recognized standing and at least one year's experience in electrical engineering work outside the college are prerequisites for consideration for this position. Special credit will be given for experience in electrical investigative work.

NEWS OF OREGON PUBLIC SERVICE COMMISSION.

The Home Telephone & Telegraph Company of Southern Oregon has been granted permission by the commission to increase its farmer party line switching rates at Medford, Gold Hill and Rogue River but refused permission to change the rates at Jacksonville. The commission also refused to permit the imposition of a penalty for non-payment of bills, and a reconnection charge of 50 cents when service had been denied subscribers for failure to pay their monthly bills. Declaring that when it fixed the present rates of the company at a former hearing that it deemed the service between Medford and Jacksonville free, the commission refused to grant the company's application to establish a toll service between these two points. The application for imposing a charge of 5 cents for calls within, and 10 cents for calls on farmer and suburban lines without the limits of the cities served, when the calls are made by non-subscribers, the commission dismissed without prejudice. The rate increases allowed for farmer party-line switching are as follows: Medford, from \$7.20 a year to \$8.40; Gold Hill, from \$3 to \$6 for residence and from \$6 to \$10 for business; Rogue River, from \$3 to \$6 for residence and from \$6 to \$10 for business.

Declaring that the parties to the contract or franchise between a city and a public utility are the only ones who can change it, Circuit Judge Galloway has set aside an order of the commission raising rates of the Western Telephone Company in Woodburn. The decision is based on the home rule amendment of the state laws. The city of Woodburn brought the suit to set aside the order, naming the public service commission and the Western Telephone Company as defendants. The decision affects a question of far-reaching importance, as it was contended, if the Woodburn franchise could be set aside by the commission, without the city's consent, other franchises would not be immune. The old franchise provided that the maximum telephone rates should be not over \$1.50 for business service, and correspondingly low rates for

residence service. Increases were ordered by the commission on all rates, and the reasons given were that the consolidation of rural lines with the city system gave the people better service, and that the company was not getting adequate returns on its investment. The commission will take the case to the supreme court.

The Coos & Curry Telephone Company has requested permission from the commission to raise the rates on telephones in Coquille and Myrtle Point and has encountered objections in Coquille from the municipal administration. City Attorney J. J. Stanley has given an opinion that the law permitting the public Service Commission to fix such rates is unconstitutional.

NEWS OF CALIFORNIA WATER COMMISSION.

Joseph H. and Laura B. Meredith of Willow Ranch, Modoc county, have applied to the commission for permission to appropriate 115 acre feet per annum of the waters of Bonner Ravine, tributary to Goose Lake in that county, for irrigation purposes. The estimated cost of bringing the water to the land is \$1000.

C. J. Laird of Mt. Dome, Siskiyou county, has applied to the commission for permission to appropriate five second feet of the waters of Lower Klamath Lake for irrigation purposes. It is proposed to raise the water 22 ft. by means of a pumping plant and to carry it to 200 acres, at an estimated cost of \$4000.

Harry A. Cole of the Hellman Building, Los Angeles, has applied to the commission for permission to appropriate sixty miners' inches of the waters of Antelope Creek in San Bernardino county for mining and milling purposes. By a pipe line half a mile in length, it is proposed to carry the water to the tungsten mines located on the summit of Altura mountain, at an estimated cost of \$2000.

E. G. Hopson and A. L. Conrad of Red Bluff, Tehama county, have applied to the commission for permission to appropriate 130 second feet of the waters of Red Bank Creek in that county for use of an irrigation project, which the applicants state it is the intention to form under the laws of the state. In the plan there is proposed a concrete arched masonry dam, 130 ft. high, 400 ft. on top and 60 ft. on bottom, a reservoir to impound 30,000 acre feet, the proposed works to cost in the neighborhood of \$400,000. The land intended to be irrigated comprises between 10,000 and 15,000 acres. Six months' time is asked the commission to perfect the plans.

Barclay McCowan of Bakersfield has applied to the commission for permission to appropriate 10,000 second feet of water from the flood waters of Kern River for purposes of irrigation. In his application Mr. McCowan says that he acts as trustee for the people of the county, preceding the formation of an irrigation district under the laws of California. The applicant asks time in which to file maps and other data.

The Guarantee & Investment Company of Hanford, Kings county, has applied to the commission for permission to appropriate 250 second feet of the waters of Cross Creek, tributary to St. Johns and Kaweah rivers, in Kings county, for the purpose of irrigating rice, alfalfa, grain and other crops. The applicants propose a canal five miles long to be known as the Lake Land, Canal & Irrigation Company, for the purpose of irrigating some 4000 acres of land. The estimated cost of the system as outlined is \$15,000.

Frank A. Greene, T. P. Ames, S. E. Greene and J. W. Long of Ono, Shasta county, have applied to the commission for permission to appropriate 500 miners' inches of the waters of the Middle Fork of Cottonwood Creek for the purpose of mining and milling gold quartz ore.

Elof Swanson of Alturas has applied to the commission for permission to appropriate 180 acre feet per annum of the waters of the east fork of Rattlesnake Creek, tributary to

Pit River for irrigation purposes. The applicant will require one and one-half miles of pipe to carry the water to 155 acres at an estimated cost of \$600.

Abbie L. Andrews has applied to the commission for permission to appropriate three second feet of the waters of Kelsey Creek, tributary to the Santa Maria and Cuyama River in Santa Barbara county. The applicant proposes to divert the water by means of a concrete dam eight feet high, 20 ft. on top and 15 ft. on the bottom, into a ditch one mile long for use in 80 acres. The estimated cost of the work is \$1000.

SAN FRANCISCO ELECTRICAL LEAGUE BASEBALL.

The season is now well on its way, after five weeks' play. The teams are all well lined up and have reached the point where good team work is shown, and they are getting down to playing real baseball. The rooters have at last awakened to the fact that the boys are playing "some" ball and have turned out in full force to the last few games, which has undoubtedly helped to make a better showing. Arrangements are now under way for a "cup" to be presented to the winning team at the close of the season. This should create keener competition between the teams and enliven the interest of the rooters. The games of last Saturday, May 20th, were played on the Ocean Shore grounds, at Twelfth and Mission streets.

Ermsco and Pacific States Game.

The game opened with Pacific States at the bat, and they seemed to get the drop on the Ermsco boys right from the jump, landing on them for five hits and three runs in the first inning and for two more runs in their half of the second inning, the Ermsco boys failing to bring in any runs, although getting several men on the bases. In the first of the third inning, Lane of the Pacific States knocked a two-bagger and was scored with a hit made by the next man up, and in the first of the fourth inning, Kennedy of the Pacific States knocked a three-bagger and stole home. The Ermsco boys seemed to be still out of luck, not being able to get a man over the home plate. The fifth inning marked a one, two three put-out for both teams. In the first of the sixth inning the Pacific States managed to get two more men over the rubber, and the Ermsco boys at last succeeded in bringing in a run. In the first of the seventh inning the first three men of the Pacific States were put out, and the Ermsco boys came in for a rally and scored two men, the third man out leaving three men on bases. In the eighth inning neither team were able to get a man to first base. The game was called at this time with a score of 9 to 3 in favor of the Pacific States, who again defended their title of league leaders.

Electric Appliance and Western Electric.

This was a hard-fought battle from start to finish, both teams making several hits and runs in almost every inning. The game started with Western taking a lead of eight runs in the first inning, but after that they were held down to a few runs each inning. The Appliance boys got next to themselves and managed to climb perilously near the Western score, with the result that from the fifth inning on it was a regular swatfest on both sides, both teams running neck and neck and finally ending in the last of the ninth with the score of 15 to 14 in favor of the Westerns.

Stranding of the Teams.

	Won.	Lost.	Pct.
Pacific States	5	0	1000
Western Electric	3	1	750
Electric Appliance	1	3	250
General Electric	1	3	250
Ermsco	1	4	200

TRADE NOTES.

The Pacific Electric Manufacturing Company, switch-gear builders, formerly located at No. 80 Tehama street, have moved to 827 Folsom street, San Francisco.

The Decker Electrical Construction Company of San Fran-

cisco secured a nice contract from the Union Iron Works for their new hospital, amounting to approximately \$250,000.

The Indian Electric Works, San Francisco, a new concern, has been the recipient of several good contracts during the past week, one at 128 Third avenue, another at 1463 Post, 1261 Lombard and 928-30 Hampshire street.

The Electric Appliance Company is completing their new demonstration room at San Francisco to be used by the electrical dealers and contractors for their prospects, demonstrating electric specialties. The room is equipped with every detail in illuminating electric appliances.

The California Electric Construction Company of San Francisco installed all the wiring and electric equipment for the German Relief Bazaar at the Civic Auditorium. The electric lighting of many designs with a roof imitating heaven, showing stars, moon, etc., is most effective.

Frank L. A. Graham and Ford W. Harris announce the retirement of F. M. Townsend from patent practice. The dissolution of the firm of Townsend, Graham & Harris, and the formation of the firm of Graham & Harris, patent attorneys, 933 Higgins Building, Second and Main streets, Los Angeles.

G. A. Weeks, manufacturers' agent, formerly in the Pacific Building, has opened up an office and store at 17-19 Main street, San Francisco, renting and repairing motors, with Floyd Seger, under the firm name of the Electric Products Sales Company. They are agents for the Wotton Rexolux and Battery Charging Equipment, also electric trucks that were used at the P. P. I. E. for freight transportation purposes.

The Westinghouse Electric & Manufacturing Company was awarded the contract for 3000 high tension insulators, and the Pierson-Roeding Company was awarded the contract for the same number of high tension pins, to be used on the California-Oregon Power Company's Trinity Center Line. The work on the Klamath River dam has been progressing rapidly, and they expect to have one unit of 10,000 kw. in operation about the first of November.

The Rice Land & Products Company have added a third pumping plant to their Colusa County equipment. This plant consists of a 36 in. Byron-Jackson pump, driven by 100 h.p., 440 volt Westinghouse motor. This pump supplies water to about 2000 acres of newly developed rice land. The total installed capacity on this property amounts to 550 h.p., and the total rice acreage for the season is 5230 acres. These properties are being managed by C. F. Adams, formerly connected with the Pacific Gas & Electric Company. This is the biggest single rice field in California.

The Gamewell Fire Alarm Company has recently installed fire alarm systems at Bremerton, Washington; Baker City, Oregon; Carson City, Nevada, and Auburn, California. The three first had installed the Diaphone compressed air plant, which is automatic, and Auburn has the town bells for public alarm. This company installed six circuit storage battery equipment in addition to their regular system at Ogden, Utah. Salt Lake is adding ten perfect non-interfering and successive fire alarms to their regular fire alarm systems, while the police department is installing 25 flashlights.

The Century Engineering Club, an organization of the employes of the Century Electric Company, St. Louis, Mo., held its second annual banquet and smoker, Tuesday evening, May 2d, at the Mercantile Club. Over 175 plates were reserved for the members and the officers of the company. D. S. Kramer, special representative of the Century Electric Company, the principal speaker of the evening, gave an illustrated talk on his experiences in the various foreign countries which he recently visited. Several musical and vaudeville numbers by members of the organization completed the program.

SALIENT FEATURES OF N. E. L. A. PAPERS.

(Continued from page 417)

the fallacious policy of giving away ranges or selling them at ridiculous prices.

"Publicity" is handled by F. Wardell, who points out the inefficiency of a large amount of advertising material furnished to central stations by manufacturers. The reason for this is analyzed and the following recommendations made: Every manufacturer's advertising department should have a man in the capacity of a printing service expert, who should be on the mailing list of every central station. Working with him should be a staff of copy writers and follow-up service makers, who would make up campaigns. It is good to remember that: (1) The value of an advertising department evidently cannot be measured by the quantity of material it sends out or the number of people it employs. (2) The value of the advertising depends upon the quality and not the quantity of things printed. (3) The value of a manufacturer's advertising material will increase in direct proportion to the number of people who know the men who write it. (4) There should be a clearing house for manufacturers' advertising departments, through which useless advertising may be eliminated. Appended to the report is a very complete and valuable bibliography of merchandising and selling, to March, 1916, arranged under six general and thirty sub-headings, compiled from a long list of magazines and other available sources.

Wiring has been divided among several subjects. The standardization of plugs and receptacles has been considerably advanced by most of the manufacturers agreeing to rate receptacles designed for branch or lighting circuits at 660 watts and the 1915 Code has made it clear that more than one such receptacle may be used on lighting circuits. Through the labors of the committee, the plugs and receptacles of many manufacturers are now interchangeable so far as one fitting the other is concerned. Considerable space is devoted to the discussion and illustration of concentric wiring plans and fittings, which have recently been placed on the market. "It is only likely," says the committee, "that this wire may be developed to be as useful for making extensions in office buildings, factories, etc., as for wiring small residences." In regard to the use of solid neutral the committee believes that most inspection authorities will approve the construction with solid neutral when the matter is properly laid before them and that the result will be a distinct saving to the consumer. In regard to the obedience to the Safety Code it is stated that "any electric service is so much safer than the service it replaces that even the most simple electric wiring is usually an improvement." Also that "we should never require wiring to be so expensive that something cheaper and hence more dangerous is used instead." The report touches on the adoption of Cushing's Standard Wiring book, the need of the standardization of screw threads, the advisability of coloring the neutral wire, and the standardizing of the appliance ends of flexible cords and the connection between house wiring and the electric range. The report is profusely illustrated by cuts of fittings and halftones of a number of European and American concentric wire installations.

Electric range committee's report will be published in full in these columns, commencing next week. Further reference appears on editorial page.

The Lamp Committee report points out that the aggregate sales of lamps for domestic purposes, exclusive of miniature, for the year 1915 totaled slightly over 110,000,000, an increase over 1913 of 10 per cent. The average candlepower of lamps sold during 1915 was 42.23, or nearly $2\frac{1}{2}$ times the average candlepower represented by the sales during 1907. Much attention has been given to the improvement of the "focus type," Mazda C lamps, used for footlighting and headlights.

Photographic lighting, light projection and lighting outdoor sports at night are discussed. The lumen is recommended as the best unit for rating lamps. A voltage directory of all cities is being prepared by the lamp companies. Member companies should control the lamp situation in their respective communities.

Artificial ice is made either by the simple drop-pipe system with removable cans, cans permanently fastened in tank or the high pressure air system with removable cans. "Taking investment and service into account, the capacity best suited for a 100-ton plant appears to be about 3000 tons general and 200 tons daily capacity." Many data in the form of tables are furnished on "Operating Comparisons" between oil engines, steam engines and central station service, and from the comparisons the latter shows up well. In Chicago there are 18 plants operated entirely by central station service, 17 of these being raw-water and one a distilled-water plant.

Considerable space in the report is devoted to plant operating data, and it is shown that the average kw.-hr. per ton for combined operation was 4.16, and this included lighting and storage refrigeration as well as all ice-making. The average water cost per ton of ice made, exclusive of sweet water for cans, which is 1.55 cents per ton, was .93 cents per ton, and a water loss average for all purposes of 20 cu. ft. to the ton of ice produced. The report concludes with a directory of electrically operated ice plants in the United States, and eleven full-page illustrations of a number of such plants.

Industrial electric heating includes all industrial application of electric energy in which direct conversion into heat energy is the desired result. Its use far exceeds the energy consumed for power purposes. Four companies alone have a total industrial electric heating load of about 70,000 kw., one having a connected load of 20,000 kw. in japanning ovens alone, and another a load of 17,000 kw. in commercial irons. Seven advantages of electric heating are pointed out, namely, that the heat is absolutely independent of temperature; the efficiency of its utilization may be made independent of the temperature at which a process is conducted; it is independent of the atmosphere in which it is generated or applied; it embodies wonderful adaptability; is susceptible of perfect and automatic control; is independent of combustible material and is the most cleanly. Six points on the proper methods of utilization are discussed, and a chapter is devoted to the subject of furnaces for various operations, as well as japanning ovens, core driers, baking ovens and special applications. The author makes the following recommendations: 1—The division of the field along certain easily distinguished lines of demarcation, such as he presents. 2—An appropriation of \$2000 annually to defray the expenses in connection with carrying out recommendation. 3—Arrange for the collection and compilation of data applying to industrial electric heating and disseminate such information among the member companies.

The Resistance Heater as a Load Builder, by Edgar F. Collins, deals only with the application of electric heat in industrial processes that require 500 degrees, Fahr., or less. Three types of units are considered, namely, the air heater unit, the cast in or embedded unit, and the immersion type unit. The first is well adapted for room and oven heating in conjunction with automatic controlling devices, the second type for the melting of metal and wax, and the immersion type for the heating of liquids. The report contains numerous illustrations showing commercial applications and summarizes the advantages of electric heat.

Electric furnace installations are increasing, particularly steel furnaces. The continued successful operation of most

of them gives conclusive evidence that the electric steel furnace is a commercially sound proposition. Four sets of tables are presented, showing the status of the art as regards the number and types of furnaces in use at the beginning of 1916 in the United States and Canada. Various tables are given showing the cost of production of the steel by different processes. A rate of 1 cent per kw.-hr. or even somewhat above this figure, is considered satisfactory by the steel people for an ordinary electric steel furnace load, together with the corresponding rolling mill and miscellaneous power load. The demand for power will vary from 200 to 300 kw. per ton capacity of the furnace for the furnace load alone. There are only two electric ferro-manganese furnaces in use in the United States, but these may be taken as a forerunner of the more extended adoption of this method. A chapter is devoted to non-ferrous metal furnaces, electrically heated enameling ovens and forging furnaces, for which there is an enormous field open to manufacturers.

Electric welding is discussed by Sidney R. Dresser from the historical and descriptive standpoint, together with a discussion of the merits of the principal systems in use. A table shows the extent of the field for butt or spot and arc welding, 32 different industries being enumerated. From a central station standpoint spot and butt welders are not a much-to-be-desired load, excepting insofar as they generally are used during daylight hours. The load factor is extremely poor. The situation is considerably better with arc welding, the load factor being about 75 per cent with the carbon electrode process and 50 per cent with the metallic electrode. In the case of resistance welding, on account of the nature of the load, it appears logical to charge a straight demand rate rather than a straight kilowatt hour rate. The author presents in the form of tables data on power costs for spot welders, time of various jobs of arc welding and their cost, cost of repair jobs accomplished by the arc method compared with the costs of the old method, comparative labor costs of blacksmith welded and electric arc welded rings, relative costs and speed of welding steel plate work by electric arc and oxy-acetylene processes, all favorable to the electric processes. In Appendix I the author has compiled information regarding spot welders, in Appendix II actual kilowatt-hour figures and test figures regarding installations in New York City, and in Appendix III a very complete bibliography of electric welding.

The lighting sales bureau presented commercial data on lighting under the following sub-divisions—highway and municipal, industrial and yard, residence, stores and public buildings, electrical advertising, and training salesmen. Abstracts of most of these reports follow:

Municipal and Highway Lighting.—Total revenue has been increased by the introduction of the new lamps. Reduction in cost per unit invariably creates an increased demand for the service. Today the single lamp unit is usually preferred in place of the cluster system. Five methods of evolving and selling street lighting systems are discussed, and their relative merits pointed out. It is shown that in no state is there a legislative act providing for the expenditure of state funds for the lighting of public highways, and there are relatively few instances where highways outside of municipal boundaries are lighted at the expense of counties. Considerable space is devoted to a description of the "Lighting District" method, in vogue very largely in the territory served by the Southern California Edison Company. In the opinion of the committee the subject of lighting of public highways not under municipal control is deserving of the careful attention of the member companies.

Industrial and yard lighting offer a wide field. Details of successful methods of obtaining factory business are given

together with a complete discussion of the design of industrial lighting systems, these being illustrated by typical installations. Good lighting increases efficiency, reduces accidents, decreases spoilage, improves output, helps accuracy, betters inspection, reduces eye strain and improves working conditions. Factory lighting straightens the load curve. The new color matching lamps are particularly valuable in many industries. Good lighting methods are also being adopted for railway yards, playgrounds, beaches, building construction, tennis courts, trap shooting and other outdoor sports, police protection, ice cutting, etc. The report concludes with a discussion on legislation and lighting codes.

Store and public building business requires well-trained salesmen to secure it. Contracts for installation should preferably be apportioned among electrical contractors, adding ten per cent to the contract price to cover cost of collecting and handling the account. Advertising effort is most productive in the early spring and fall. A flat rate for window lighting is inadvisable, the installation of a time-clock being suggested. Show-case lighting has been neglected and offers great opportunities as also do interior signs. Churches and buildings under construction are a good field for illuminating sales effort. The lighting salesman, because of his close affiliation with merchants, can do much to instill the necessary "booster" spirit.

Electrical advertising has brought to the central station more new business than was known to have existed. Flood lighting receives considerable attention. "Light seems to produce a pleasing effect on the human race, for we walk along the best lighted streets, we stop in the best lighted stores and amuse ourselves in the best lighted places." Considerable installation and illumination data are given in the report, and several forms of projectors are illustrated. If two projectors, it is stated, are trained on the same area, the intensity will be doubled, if trained side by side, thus keeping the intensity constant, the area lighted will be doubled. The advantages for using the floor lighting projects for billboard lighting are at once apparent, for it can be installed in practically any convenient place; complicated wiring is eliminated, and the working hours for the billboard are greatly increased. Chapters are devoted in the report to flood lighting of public buildings and rifle ranges, its use during construction work, for winter sports and pageants. Considerable space is devoted to the impetus given to the electric sign business in the United States through the introduction of the electric American flag. Chapters are devoted to slogan signs, electric roof signs and factory signs, outlining and outside illumination. The newly developed motor-graph traveling letter sign is described and highly recommended. The report concludes with the suggestion that the central stations have one or more signs of their own, as it is practically impossible to secure electric advertising unless an example is set by those who will enjoy the most benefit.

Residence lighting with electricity is still lacking in 15,000,000 dwellings in the United States. Details of successful house-wiring campaigns are given, including general and campaign advertising.

The committee summarizes its conclusions as follows:

1. The central station should have a complete analysis of the field.
2. The cost factor should be met by arranging the terms of payment.
3. Central stations should have a satisfactory working plan with contractors who are engaged in wiring.
4. The homeowner's interest must be stimulated to one of monetary desire by adopting campaign methods.



NEWS NOTES



INCORPORATIONS.

LOS ANGELES, CAL.—American Fire Alarm Company has been incorporated with a capital stock of \$15,000, by C. A. Wilson, J. M. Marshall, J. L. Trenchard, R. J. Craft et al.

ILLUMINATION.

YUMA, ARIZ.—The Yuma Ice Company is preparing to install an electric light and power system.

SAN GABRIEL, CAL.—The city trustees have awarded a gas franchise to the Los Angeles Gas & Electric Corporation.

LOS ANGELES, CAL.—The board of supervisors will hear a petition on June 5th asking for the formation of the Bonita Meadows Lighting District.

OAKLAND, CAL.—Bids will be received until noon, June 1, by L. W. Cummings, city clerk, for construction of 24 ornamental lighting posts on Grove street.

SAN LUIS OBISPO, CAL.—The Santa Maria Gas & Power Company has begun laying gas mains from the southern border of the city to the Polytechnic school.

EL PASO, TEX.—No further franchises will be granted for the erection of electric light or other wire supporting poles and in future all wires will have to be placed under ground.

HUNTINGTON BEACH, CAL.—The city trustees have ordered the city clerk to advertise for bids for \$10,000 of the \$20,000 bond issue voted last December for the purpose of installing a municipal gas system.

SAN PEDRO, CAL.—Progress is being made in the movement to secure ornamental lights for Sixth street from Beacon to Pacific avenue. A petition asking for the installation of the system is now in the hands of city officials.

NORTHPORT, WASH.—The council has under consideration a proposal for a municipal light and water system. A Portland company which has had a representative here looking over the ground estimates the cost at \$25,000. No definite action has been taken.

OCEANSIDE, CAL.—A deal has been closed whereby the San Diego Consolidated Gas & Electric Company acquires the majority of the stock of the Oceanside Gas & Electric Company, which furnishes light and power for this city and the San Luis Rey Valley.

LOS ANGELES, CAL.—The board of supervisors has authorized the chief mechanical engineer to prepare plans for an ornamental lighting system in the Graham Lighting District. The contract for additional lighting posts in the Westgate Lighting District has been awarded to B. S. McEwan.

LOS ANGELES, CAL.—Plans for the formation of a Peoples Gas Company to take over the holdings of the Southern Counties Gas Company and the gas projects of other public utility corporations in the smaller towns and cities of Southern California have been abandoned, according to an announcement made in San Pedro. The Southern Counties Company will take over the properties of the other and smaller companies issuing stocks and bonds instead of having a new corporation formed.

SALT LAKE CITY, UTAH.—The Utah Gas & Coke Company of Salt Lake City and the Welsbach Street Lighting Company of Chicago propose to make a strong fight to secure a part of the street lighting of Salt Lake City when the present contract with the Utah Power & Light Company expires on December 31, 1916. Heretofore, all of the city street lighting has been done by electricity under contract of the power company. R. W. Bingham of the Welsbach Company is in

Salt Lake City and has made a proposition to the city commission to make a sample installation to demonstrate the efficiency of gas for street lighting. The company wishes to secure the contract for the lighting of the northeast bench section of the city with gas.

TRANSMISSION.

IDAHO FALLS, IDAHO.—N. M. Holm, manager of the Ashton & St. Anthony Power Company, has made application for a franchise to furnish electric power for heating purposes at Ashton.

KLAMATH FALLS, ORE.—Project Manager J. G. Camp of the reclamation service, in behalf of the Klamath Water Users' Association, has asked for a franchise for a high power line through Klamath Falls.

GRASS VALLEY, CAL.—Work has started on a new power line to supply electric current for the plant at the Allison Ranch mine, which will be reopened by the Grass Valley Consolidated Mine Company.

PROSSER, WASH.—The Grandview Irrigation District has made application for a franchise for the construction of an electric transmission line on the road running east and west through section 30, township 9 north.

PLACERVILLE, CAL.—The Pacific Gas & Electric Company has begun a suit in the superior court for the condemnation of land in this county which the company desires for right of way for an electric transmission line. The company is building an electric transmission line from Nevada to San Joaquin county.

VENTURA, CAL.—The Ventura County Power Company was the only bidder for a franchise for conveying power over the county. Permission is given to construct pole lines in various parts of the county outside incorporated cities. The entire county is covered except the Ojai Valley now served by a local corporation.

YREKA, CAL.—The California-Oregon Power Company has preparations under way for the building of a power line from Casella to Weaverville. Superintendent O. G. Steel has left for Carville to install a temporary electric power plant, for a large dredger at that place, pending the entry of the company's high power line. A surveying party will start work on the line from Castella under the direction of Howard O'Connor, the power company's engineer at Yreka.

LOS ANGELES, CAL.—Negotiations looking toward the city's purchasing the private distribution systems of the three power companies are to be entered into at once by the city and the companies. The board of public service commission has authorized plans drawn for a shop building to be constructed in connection with the central distributing station and for a substation to be installed in the Garvanza district.

TELEPHONE AND TELEGRAPH.

OAKDALE, CAL.—The field committee of the Oakdale Irrigation District has been instructed to investigate the cost of extending the telephone system at Lone Tree.

SAN MATEO, CAL.—The Pacific Telephone & Telegraph Company has purchased a lot in Hillsborough and soon will start construction of a building to house its peninsula officials.

WINTERS, CAL.—The Pacific Telephone and Telegraph Company will begin work in about a month rebuilding its line between Winters and Monticelo. The work will cost about \$5000.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

- | | | |
|---|---|----|
| A-1 American Ever-Ready Works of National Carbon Co.
Los Angeles; 755 Folsom St., San Francisco; Seattle. | M-3 Moore & Co., Charles C.
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland;
Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco;
Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson. | 3 |
| A-2 Atchison, Topeka & Santa Fe Railway Co.
673 Market St., San Francisco; 1218 Broadway, Oakland. | N-1 Nason & Co., R. N.
151 Potrero Ave., San Francisco. | |
| P 1 Baker-Joslyn Company
71 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 E. Second St., Los Angeles. | N-6 National Carbon Company
Cleveland, Ohio. | 3 |
| 3-2 Benjamin Electric Manufacturing Co.
590 Howard St., San Francisco. | N-2 National Conduit & Cable Co., The
Trust and Savings Bldg., Los Angeles; Rialto Bldg., San Francisco. | |
| B-5 Bridgeport Brass Co.
(See Pierson, Roeding & Co.) | N-3 National Lamp Works of G. E. Co.
(All Jobbers.) | 14 |
| C-1 Century Electric Co.
906 So. Hope St., Los Angeles; 58 Natoma St., San Francisco; 65 Front St., Portland, Ore. | N-4 New York Insulated Wire Co.
629 Howard St., San Francisco. | 5 |
| C-3 Crocker-Wheeler Co.
Crossley Bldg., 518 Mission St., San Francisco; 228 Central Avenue, Los Angeles. | N-5 Northwestern Pacific Railroad
808 Phelan Bldg., San Francisco. | 11 |
| C-4 Cutler-Hammer Manufacturing Co.
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(All Jobbers.) | 14 |
| D-4 Davis Slate & Manufacturing Co.
Chicago, Ill. | P-1 Pacific Electric Manufacturing Co.
80 Tehama St., San Francisco. | |
| D-2 Dearborn Drug and Chemical Works
355 East Second St., Los Angeles; 301 Front St., San Francisco. | P-2 Pacific States Electric Co.
236-240 So. Los Angeles St., Los Angeles; 61-67 Fifth St. No., Portland; 200-210 Twelfth St., Oakland; 575 Mission St., San Francisco; 307 First Ave. So., Seattle. | 2 |
| E-7 Economy Fuse & Mfg. Co.
Kinzie and Orleans Sts., Chicago. | P-4 Pelton Water Wheel Co.
2219 Harrison St., San Francisco. | 4 |
| E-1 Edison Lamp Works of General Electric Co.
Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles. | P-5 Pierson, Roeding & Co.
Pacific Electric Bldg., Los Angeles; Rialto Bldg., San Francisco; Colman Bldg., Seattle. | 4 |
| E-2 Edison Storage Battery Supply Co.
441 Golden Gate Ave., San Francisco. | P-6 Pittsburgh Electric Specialties Company
202 Aronson Bldg., San Francisco. | |
| E-3 Electric Agencies Co.
247 Minna Street, San Francisco; Central Building, Los Angeles. | P-7 Pittsburgh Piping & Equipment Co.
Monadnock Bldg., San Francisco. | 14 |
| E-6 Electric Novelty Works
533 Mission St., San Francisco. | S-1 Schaw-Batcher Company, Pipe Works, The
211 J St., Sacramento; 356 Market St., San Francisco. | |
| E-4 Electric Storage Battery Co.
743 Rialto Bldg., San Francisco. | S-4 Southern Pacific Co.
Flood Bldg., San Francisco. | 4 |
| E-5 Electric, Railway & Manufacturing Supply Co.
34 Second St., San Francisco. | S-5 Sprague Electric Works
Rialto Bldg., San Francisco; Colman Bldg., Seattle; Corporation Bldg., Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane. | 4 |
| F-1 Fairbanks, Morse & Co.
Los Angeles; Portland; 651 Mission St., San Francisco; Seattle; Spokane. | S-6 Standard Underground Cable Co.
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Yeon Bldg., Portland; Central Bldg., Seattle, Wash. | |
| F-3 Federal Sign System (Electric)
618 Mission St., San Francisco. | T-1 Thomas & Co., R.
Pacific States Electric Co. and Western Electric Co., Pacific Coast Representatives. | |
| G-1 General Electric Co.
724 So. Spring St., Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane. | T-2 Tubular Woven Fabric Company
Pawtucket, R. I. | |
| G-1 General Vehicle Co.
1117 Van Ness Ave., San Francisco; 331 Wall St., Los Angeles; British Columbia Electric Ry., Ltd., Vancouver, B. C. | U-1 Union Sheet Metal Works
575 Howard St., San Francisco. | |
| H-1 Habirshaw Wire Co.
(See Western Electric Company.) | W-1 Wagner Electric Manufacturing Company
St. Louis, Mo. | 3 |
| H-2 Hemingray Glass Co.
236-240 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco. | W-2 Western Electric Co.
Eighth and Santee Sts., Los Angeles; 1901 Telegraph Ave., Oakland, Cal.; 680 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore. | 5 |
| H-5 Hunt, Mirk & Co.
141 Second St., San Francisco. | W-4 Westinghouse Electric and Manufacturing Co.
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; 165 Second St., San Francisco; Second and Cherry Sts., Seattle; Paulsen Bldg., Spokane. | 6 |
| H-7 Hurley Machine Co.
New York and Chicago. (See Pacific States Electric Co.) | W-5 Westinghouse Machine Co.
141 Second St., San Francisco. | |
| I-2 Illinois Electric Co.
261-263 So. Los Angeles St., Los Angeles. | W-6 Westinghouse Lamp Co.
(See Westinghouse Electric & Manufacturing Co.) | |
| I-3 Interstate Electric Novelty Co.
111 New Montgomery St., San Francisco. | W-8 Western Pipe & Steel Co.
444 Market St., San Francisco; 1758 North Broadway, Los Angeles. | |
| L-1 Leahy Manufacturing Co.
Eighth and Alameda St., Los Angeles. | | |
| L-2 Locke Insulator Manufacturing Co.
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| M-2 McGlaughlin Manufacturing Co.
Sunnyvale, Cal. | | |
| M-4 Morse Chain Company
Monadnock Bldg., San Francisco. | | |

JOURNAL OF ELECTRICITY

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SAN FRANCISCO, JUNE 3, 1916

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LAYING SUBMARINE POWER CABLES ACROSS SAN FRANCISCO BAY.

BY J. A. KOONTZ AND L. P. CORNELL.

FEASIBILITY OF ELECTROCHEMISTRY AT THE DALLES.

BY O. F. STAFFORD.

REPORT OF N. E. L. A. RANGE COMMITTEE.

MUNICIPAL OWNERSHIP OF RAILWAYS AT SAN FRANCISCO.

HAZARDS OF ELECTRIC HEATERS AND RANGES.

BY G. A. CLEARY.

MATERIALS ADVERTISED IN THIS ISSUE

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Electric Storage Battery Co.
National Carbon Co.

Boiler Feed Water Treatment

Dearborn Chemical Co.

Chain Drive

Morse Chain Co.

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Sprague Electric Co.

Electrical Slate

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JOURNAL OF ELECTRICITY

POWER AND GAS

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LAYING POWER CABLES ACROSS SAN FRANCISCO BAY

BY J. A. KOONTZ AND L. P. CORNELL

(This paper describes the latest feat of the Great Western Power Company in laying a cable across San Francisco Bay. It was presented at the May 26th meeting of the San Francisco section of the American Institute of Electrical Engineers. The authors are engineers with the Great Western Power Company.—The Editor.)

Submarine power cables were first proposed for transmitting power under San Francisco Bay some twelve years ago by S.L. Naphthaly, then with the San Francisco Gas & Electric Company. At this early date the cable manufacturers would not attempt building a submarine cable larger than three No. 2 B. & S. gage wires insulated for 15,000 volts. Three years later they were only in a position to build a 4/0 15,000 tape armored cable.

still in operation. The first submarine cable was a 4/0 three conductor, 15,000 volt cable.

In 1912 the Great Western Power Company installed its first 22,000 volt cable across the Carquinez Straits. This was a tape armored, varnished cloth insulated cable, and hence it was necessary to use some means for taking care of the mechanical strain. So a messenger cable was used, to which the tape armored cable was served, leaving sufficient slack in the power

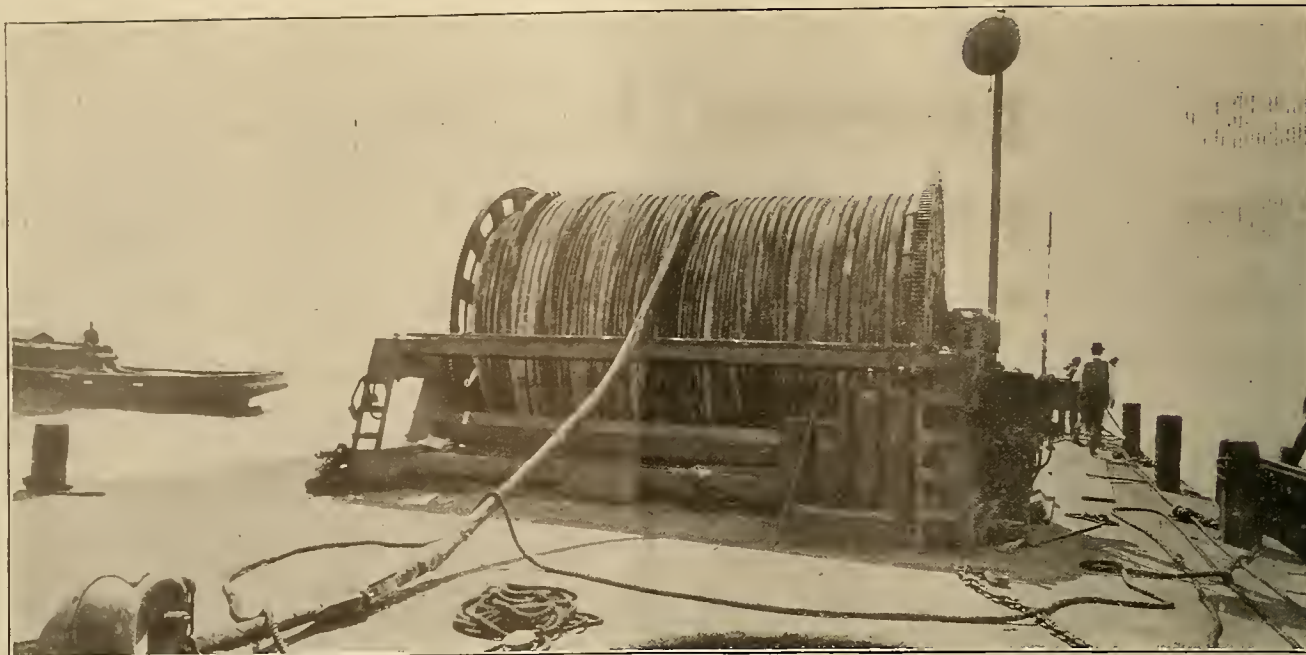


Cable Laying Barge.

The engineers and directors of the various power companies were skeptical concerning the reliability of such cables and would not sanction the installation of one until late in 1911, when the management of the Great Western Power Company decided to install a 15,000 volt cable across San Francisco Bay to connect the 11,000 volt distributing system of the Great Western Power Company in Oakland with that of the City Electric Company in San Francisco. This cable was first placed in operation in January, 1912, and is

cable so that all mechanical stress would be thrown on the messenger. This method of using a messenger cable was later patented by Mr. A. J. Pahl and the method in detail of laying cables in this manner was very ably presented in a paper before the Institute by Mr. Lisburger of the Pacific Gas & Electric Company.

A person not familiar with submarine cable installation cannot fully realize the strains to which a cable is subjected during the process of laying. Triplex cables of 250,000 to 300,000 c.m. sizes have a weight



Reel With 8500 Ft. of Cable, Weight 106 Tons, Reaching from Goat Island to San Francisco.

of about twenty to twenty-five pounds per foot, and when these are being laid in water from fifty to one hundred feet in depth and the barge is subjected to swells from ferryboats or other vessels there is a sudden impact which in the past caused a great deal of trouble.

The conductors of the first cable were insulated with $5/32$ in. of 30 per cent para rubber compound taped with $2/32$ in. varnished cloth thereover, bunched around with jute and then given a belt insulation of $6/32$ in. varnished cloth, making a total thickness of insulation between conductors and between conductors and sheath of not less than $13/32$ in. Over this belt insulation was placed a $1/8$ in. lead sheath, containing 2 per cent tin. A $4/32$ in. jute bedding was placed between the No. 4 B. W. G. galvanized steel armor wires and the sheath, a $3/32$ in. jute serving covered the armored wires, and the cable was given a final lime and sand finish.

Insulation on all three 15,000 volt cables connecting Oakland to San Francisco has been graded. The only change made in the last two cables was that of increasing the thickness of the rubber from $5/32$ in. to $6/32$ in. and the lead sheath from $1/8$ in. to $5/32$ in. In the last cable installed the stranded conductors were impregnated to prevent the creepage of moisture along same should the sheath become broken at any time.

This last cable was provided with a telephone pair which was placed in one of the jute fillers alongside of the conductors. It might be of interest to know that all the cable manufacturers at first seriously objected to placing a telephone pair in a 15,000 volt cable and it took almost six months to convince the manufacturing companies that it was feasible to use such a pair of wires for communication work and to do so without injury to the cable insulation.

On the 22,000 volt cables across the Carquinez Straits one is of graded insulation and the other varnished cloth throughout. For high voltage cables the graded insulation undoubtedly gives a better voltage

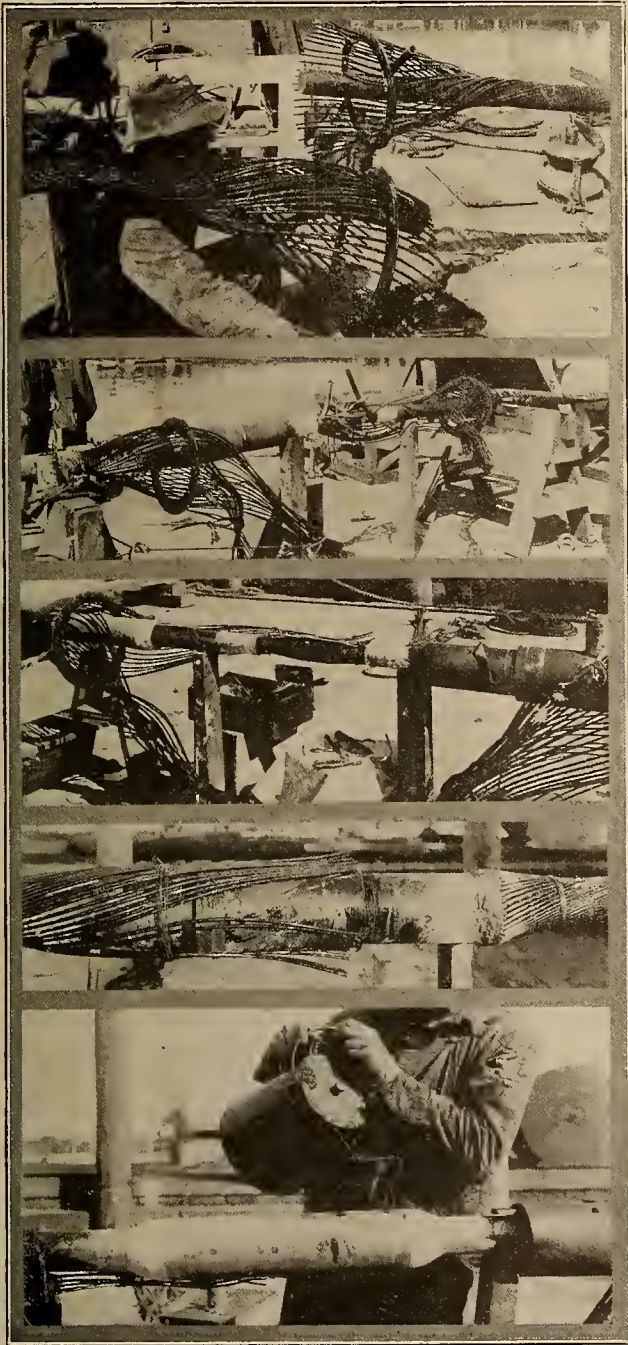
distribution throughout the insulation than the other types; but for cables of 22,000 volts or less I can find nothing from the operation standpoint that would show advantage of the graded insulation over that of a cable made of varnished cloth. I do not believe, however, that a cable that is to receive more or less rough handling should be insulated first with rubber, as there is less danger of the insulation being broken from frequent bends or other abuse. To date we have never had a failure in the insulation of a submarine cable except at a splice or where the cable had been injured from some external source.

The cable companies have been improving their methods of manufacture of submarine cables, and today we get a cable that will stand more rough handling than those we received a few years ago. They are able to place the insulating material around the conductor much more firmly and to pack the jute tighter, so that after the cable has gone through the leading presses it is quite incompressible and will stand considerable pressure without distortion.

This point is of great importance in that we can now place considerable stress on the spirally wrapped armor wires without having them imbed themselves in the cable proper and thus increase their length.

While it is true there has been some trouble at the joints of the first power cables, this trouble has been mechanical and not of an electrical nature, the difficulty being to get a mechanical connection between the armor wires such that the strain will all be taken up by the former and none transmitted to the lead or conductors.

We have had actual cases in the old type of joints where the lead sheath would be pulled apart and other cases where the lead would flow sufficiently to throw the strain on the conductors and in one instance one of the conductors pulled out of the copper connecting sleeve without injuring the insulation between the conductors or to ground, leaving this conductor open circuited and insulated.



Cable Splicing Methods—First, Laying Back Armor; Second, Conductors Bared for Splicing; Third, Conductors Ready for Belt Insulation; Fourth, Armor Welded to One End of Turnbuckle; Fifth, Lead Joint Finished.

In the first cable great stress was placed on getting a good lead covering over the joints, in fact, a double sleeve was used so that if one should become injured the joint would still be waterproof. The armor wires at splices were first single lapped, that is, the armor wires on one end of the cable were served back over the armor wires on the other end of the cable. In latter joints we tried a double lap in which the armor wires were woven back over the cable on both sides of the splice, each layer of armor being served in place, and in some cases locking rings were placed in between the layers of the armor wires in an attempt to get a tight mechanical joint between the armor wires of the spliced pieces. With this latter method

we have had very good success, but it is a tedious joint to make and is wasteful of cable, it being necessary in most cases to cut off from ten to twelve feet of cable from each end of the pieces to be spliced.

With the dense cable we are now able to buy it is possible to place all this mechanical strain on the armor and to relieve the joint. This is done by the use of a turnbuckle sleeve devised by Mr. E. W. Beardsley. This sleeve for our present installation was made of four and one-half inch extra heavy iron pipe which was cut and threaded with right and left threads and a suitable coupling used to fasten the two pieces together. The joint is made up in the usual way till after the lead sleeve is wiped. Then this sleeve is slipped over the joint, which has been carefully wrapped with asbestos. Then the armor wires are carefully laid in place and oxy-acetylene welded to the ends of the sleeve. After the armor wire has been welded to each end of the turnbuckle, the coupling is then tightened up so that the armor wire is in tension.

Elaborate tests were made before these splices were adopted. A tension of 28 tons was applied to both the armor and conductors on each side of the sleeve, first lengthwise and then by confining the turnbuckle parallel to the floor and hoisting both ends of the cable on the hook of a crane at right angles to it. This test was stopped at 28 tons because that happened to be the limit of the ring bolt in the concrete floor. A potential test of 53,400 volts was applied for five minutes between conductors without failure, and was stopped at this point because of the brush discharge between the ends of the conductors. A tension of 100 tons was later applied to the armor wires on each end of a section of the cable without causing measurable elongation or any change in its appearance.

The cable laying barge was 86 ft. x 35 ft., equipped with a reel of ordinary type 6 ft. drum, 16 ft. long, gear driven by a steam engine. The capacity of the barge was 200 tons, of the reel 125 tons. The cable was furnished by the General Electric Company in lengths of 1000 and 1308 ft. Several of these lengths were joined together to form a section suitable for laying while the barge was tied at the dock, and this work proceeded at the rate of a splice a day.

To accomplish this result the men worked in rotation. The cable splicer and his helper started the day and were followed by the welder, and he in turn by five stevedores and the donkey engineer, who placed the cable on the reel and made ready for the next splice.

When a section of desired length was formed the barge went out and laid it and returned to the dock, where the operation was repeated.

At the start, $11\frac{1}{4}$ hours elapsed in making a splice, of which 4 hours were used in welding the armor. Toward the last the workmen became more expert and finished splices required only $6\frac{1}{2}$ hours, of which 50 minutes elapsed in welding each end of the armor. Fourteen splices were made under these conditions.

The cable is divided naturally into three parts. Parts one and two are separated by a switching station located near the east end of Goat Island; parts two and three by 1200 ft. of underground across the west end of the island. Each of these parts was laid in two sections. The laying of each section began at the

shore end, and the two sections were designed to meet in the bay, the meeting point being chosen for moderate depth and avoidance of wind, tide and the usual steamer routes. The laying of each part in this manner necessitated the making of one splice in the bay, or three in all. The actual time of laying the six sections was 3 hours and 57 minutes.

During the operation of laying, the barge was towed by a 110 h.p. gasoline launch, and held on its course by a 1¼ in. steel rope attached to either shore. When the end of the power cable was put overboard in the bay it was attached to the guide rope to facilitate its recovery. After the laying of the power cable was finished the guide rope was reeled up and taken ashore. While laying, the barge was easily controlled or anchored by braking on the guide rope and the cable reel.

The first two parts were laid on an ebb tide. As the third part had an angle in its course, advantage was taken of both ebb and flood. Laying was once postponed for one day because of foul weather. As the barge could await a calm before leaving the dock and the laying occupied only a few hours, the marine risk was believed to be so slight that no insurance was carried on either barge or cable. This was to us the most gratifying feature of the whole undertaking.

The Great Western Power Company has laid and is now operating 26 submarine cables of a total length of 77,250 ft. Two are 4000 volt, three 11,000 volt and twenty-one 22,000 volt. One of the 4000 volt cables, 900 ft. long, crossing Steamboat Slough, from Grand to Sutter Island, is ordinary No. 2 triplex, lead covered, paper insulated, underground cable.

The other principal talking point is that the total cable wasted was 67 ft. cut off in splicing. For comparison, 446 ft. was wasted on No. 2 Bay Cable, the value of which was over \$1200.

The longest section of cable on the reel at one time was 8500 ft., reaching from Goat Island to San Francisco, which cable weighed approximately 105 tons.

The electrical part of each splice was the same as for ordinary underground work, except that the specifications called for superior materials and special care.

Gum-faced para compound and adhesive linen tape were used, both products being developed and furnished by the General Electric Company. Each taped conductor was calibrated to assure the proper thickness of insulation at all points. The conductors, after being taped, were wound with wrapping paper to exclude dirt or moisture, until all were ready for the belt insulation. The temperature of the ozite was taken before pouring and after it entered the sleeve. The lead sleeves were 4 in. x 20 in. and ¼ in. thick; 4/16 in. asbestos board was placed between the lead sleeve and the turnbuckle; ¾ in. holes were drilled in the turnbuckle to admit water, and the ends of the turnbuckle dammed with powdered asbestos. The turnbuckle was kept full of water during the welding process.

The elapsed time from the beginning to the end of the work was 35 days, which included time spent in rigging the barge, pulling in the shore ends and waiting for fair weather.

To protect the cable from ships' anchors it is proposed to erect an illuminated sign, legible from any point in the channel and backed by range lights accurately defining the location of the cable.

FEASIBILITY OF ELECTROCHEMISTRY AT THE DALLES.

BY O. F. STAFFORD.

(Continued.)

Cyanides.

The class of chemical compounds collectively called the cyanides fills a comparatively small although very important place in the fields of chemistry and metallurgy. The processes used in their manufacture have been various, changing from time to time as "improvements in the art" have come about. Earlier methods were based exclusively upon the decomposition at high temperatures of organic materials rich in nitrogen. Certain electrochemical products, however, such as metallic sodium, cyanamid, etc., may be used immediately in cyanide production and for this reason cheap electric power has been considered as the ultimate need in the industry.

In the last analysis it will probably appear, however, that the cheapest source of cyanides will be from residues obtained in the alcohol and beet sugar industries, and that furthermore these sources will be able to supply the whole demand. Whether this prediction ever may be fulfilled or not it is certain that no large amount of power can ever in any case be diverted into the making of cyanides for the reason that the whole world consumption is but 25,000 tons per year, the manufacture of which would require power in quantity not exceeding in any event 25,000 horsepower-years. So far as can be seen at present this world-consumption of cyanide is not likely to have any large increase in magnitude, nor would any possible reduction of price stimulate consumption greatly.

Graphite.

An electrochemical industry of minor importance is the making of artificial graphite, the sole raw material for which is said to be anthracite coal. The product is graphite of high grade which may be formed in the course of manufacture into almost any desired shape or size. The properties of this graphite make it a most useful material for a wide range of purposes, extending from its application as a lubricant in the form of the finest suspensions in water or oil to the use of massive electrodes in exacting electrochemical processes.

The production of electric furnace graphite in 1912 is given as 6500 tons. Since both the favored raw material and the market are in the East the economical manufacture of graphite at a western locality may be said to be an impossibility.

Fixation of Atmospheric Nitrogen.

Four-fifths of the atmosphere by bulk consists of the chemical element nitrogen. It exists in the air in the "free" state as opposed to the forms of chemically combined nitrogen familiar to every one as ammonia, ammonium compounds, nitric acid, sodium or potassium nitrates, etc.

It is only these latter forms of nitrogen, where the element is "fixed" or chemically combined with other elements, which are of use in the arts and industries. The enormous store of free nitrogen in the air, amounting to seventy million pounds over every acre of the surface of the earth, is consequently useless for the growing of crops, the making of dyes, ex-

plosives, medicines and many other useful things until transformed by chemical processes.

Nature apparently has provided no very rapid method for this transformation, and hitherto in the history of the world practically all stores of combined nitrogen seem to have been produced slowly by the activities of certain soil bacteria. Where the soil is cultivated without due regard to the growing at suitable intervals of crops which harbor these nitrifying bacteria the yields begin to fail and in the course of time are unprofitable.

For the purpose of replenishing the stores of nitrogen compounds in the soil where intensive agriculture is followed and at the same time supplying the nitrogen compounds used in the arts and industries a number of sources have served in the past the most important of which are the following:

(a) The nitrate deposits of Chile from which there has been obtained as much as two and one-half million tons of sodium nitrate per year. Eighty-five per cent of this amount is ordinarily used in agriculture and fifteen per cent in the industries.

(b) The ammonia obtained as a by-product in the making of coal gas and coke. Reduced to its equivalent of ammonium sulphate this substance was produced in the United States in 1913 to the extent of 200,000 short tons. The world production for the same year was nearly 1,500,000 long tons.

(c) Certain by-products from the packing house industries, cotton-seed meal, fish scrap, guano, etc.

As to the sufficiency of these sources of nitrogen compounds, it may be said that the nitrate deposits of Chile appear to be approaching exhaustion, so that within a few decades at most the recovery of nitrate will become so expensive as to be prohibitive. The recovery of ammonia from coal is an industry that will develop rapidly for years to come and this source may therefore be depended upon with confidence for increasingly larger returns. The supplies of nitrogenous fertilizer originating in the packing house, cotton seed, and fishing industries properly should to a much greater extent be diverted to use as food materials for stock, poultry, etc., so that these sources in all probability will fail practically in the course of a short time. Guano may be said to be already a thing of the past. It follows, therefore, that of the major sources of commercial nitrogen compounds only one, the production of by-product ammonia from the coke industry, can be depended upon to increase with time. It is admittedly the case that the growth in productivity of this single source will by no means keep pace with the increasing demands for nitrogen compounds for all purposes. Economists of a dozen years ago were genuinely alarmed over the outlook for a supply sufficient for the needs of agriculture alone and the prediction was made in all seriousness that the world was facing actual hunger.

Direct Oxidation of Nitrogen.—The fact that nitrogen could be chemically combined with oxygen at high temperatures has long been known. Not until 1903, however, did experiments looking toward the technical utilization of the fact hold out promise of success. Dating from the year mentioned an industry has arisen whereby the electric furnace is made to yield the necessary high temperature for the chemical process in question. The industry at the present time

is of significant magnitude, involving investments of many million dollars, and absorbing hundreds of thousands of horsepower of electrical energy. It has its main seat in Norway—partly for the reason that Norwegian engineers first solved the problem of “fixing” atmospheric nitrogen upon a commercial scale, and partly because of the unequaled water power facilities existent in that country.

At the present time there are three somewhat different processes in use based upon this direct oxidation of nitrogen. They are known respectively as the Birkeland-Eyde, the Schoenherr and the Pauling processes. All produce nitric acid which in turn can be converted into any desired nitrate. Each of these processes is lavish in its use of power, the power requirement for a short ton of nitric acid being upon an average among them about 2.7 horsepower-years. This high power consumption, however, is compensated to a degree by low costs in other respects so that with power costing not more than \$10 per horsepower-year these methods of producing nitrogen compounds are commercially profitable. Up to the present time the industry in Norway has had the advantage of water power costs said to be not more than \$6 per horsepower-year. At \$9 per horsepower-year it is estimated that these direct oxidation methods should yield nitric acid at not to exceed \$35 per ton. The corresponding equivalent costs of sodium nitrate and calcium nitrate, respectively, for conditions at The Dalles would be \$32 per ton for the sodium nitrate and \$24 per ton for the calcium nitrate, allowing \$10 per ton for the sodium carbonate necessary for the conversion into sodium nitrate and \$2 per ton for the limestone that would be used in making calcium nitrate.

The normal average price of sodium nitrate from Chile delivered at west coast ports may be taken as about \$30 per ton. The costs of making synthetic sodium nitrate are therefore practically the same as the market prices of the natural product. The tendency will be for the price of Chilean nitrate to advance continuously with time as the deposits become depleted so that eventually the cost of synthetic nitrate will determine all prices. Just at present, however, it should not be forgotten that the Chilean government levies an export duty of about \$11 per ton upon all nitrates shipped from its borders. A reduction in this duty would enable Chilean producers to deliver at prices lower than the present estimated factory costs of the synthesized material.

Cyanamid and similar processes.—An entirely different method of utilizing atmospheric nitrogen depends upon the fact that at moderately high temperatures the element combines with a number of different substances to produce compounds which may with ease be converted into ammonia.

At the present time the most successful and most largely used process coming under this classification is the manufacture of cyanamid. This substance is made by heating calcium carbide moderately while in contact with pure nitrogen gas. The calcium carbide must be made in the electric furnace previously, and it is in this detail, of course, that the dependence of the process upon cheap electrical power consists. The resulting cyanamid may be used directly as a nitrogenous fertilizer constituent, or may be converted readily into ammonia, which in turn may be

changed into ammonium sulphate, ammonium nitrate, ammonium phosphate or any other desired ammonium compound.

The power consumption in the manufacture of cyanamid is considerably less per unit of nitrogen brought into combined form than in the direct oxidation methods first discussed. Compensating cost factors enter, however, which make final totals much the same in the two cases in the localities where the two processes are now in operation together.

The data at hand do not permit any exact estimate of costs attending the proposed manufacture of cyanamid at The Dalles. The same information, however, which permits the statement that the cost of synthesized nitrogen by the cyanamid process does not differ materially from the cost of nitrogen brought into combination by the oxidation process would lead to a figure near to \$35 per short ton of cyanamid as commercially produced.

Whatever the actual cost of cyanamid may be, however, it is certain that a western plant as compared with an eastern one would be handicapped by heavier costs for all items in the manufacture excepting power and by the further fact that the low power consumption of this process would render this single advantage to be of but little significance. It is therefore certain that cyanamid manufacture in this territory must always be limited to the amount which can be marketed from a western point more advantageously than from an eastern one.

A number of substances other than calcium carbide have been tried out as media for the fixing of atmospheric nitrogen and in some instances these have been developed well into the commercial stage. Perhaps the best known among them is the Serpek process in which aluminum carbide is the active medium. Most of these process claim advantages in the way of lessened power consumption as compared with the methods discussed above. It must be pointed out, however, that reduced power costs alone, unless attended by significant reductions in the other costs of manufacture such as materials, labor, capitalization, etc., will mitigate, under the circumstances, against rather than for the establishment of such industries in the West.

The Haber process.—A third important method of securing artificial nitrogen compounds has been perfected by Dr. F. Haber, of Berlin. It consists in the direct combination of nitrogen with hydrogen, the result being the immediate formation of ammonia. The reaction proceeds in a manner suitable for commercial requirements when the gases are brought together under great pressure at about 500 deg. C.

The necessary raw materials are the two gases just mentioned together with power. Electric heating is desirable in this process, but quite possibly not an absolute necessity as in the other processes in use which operate at temperatures not attainable in furnaces heated by fuels. In any event the power consumption is stated to be small so that the process is relatively independent of cheap electric power.

Reliable cost data for this process are not available. The gases used must be of exceptional purity so that the opinion is held by some that only where hydrogen, particularly, can be obtained very pure as a by-product will it be possible for the method to

compete with the older processes. With electrical energy available at a price of \$9 per horsepower-year, however, it should be possible to make hydrogen as a primary product without consideration of any return from by-products of its own, such as caustic, oxygen, or whatever else, at a price well under 15 cents per pound, the power costs alone being but 4 cents per pound. Nitrogen, at the outside, should cost not more than 1 cent per pound. Based upon these prices the gases necessary for making one pound of ammonia would cost about $3\frac{1}{2}$ cents. Assuming all other factory costs to amount to 2 cents per pound of ammonia produced the total cost of the product would amount to $5\frac{1}{2}$ cents, a figure comparing not disadvantageously with the other established methods.

As a matter of fact it probably will develop that ammonia may be made by the Haber process at a cost somewhat lower than the above estimate. The required gases may be had at a lower figure almost certainly. Factory operating costs are entirely unknown, however, and can be judged only by the esteem in which the process seems to be held by its present owners, the Badische Anilin and Soda Fabrik. It is known that this powerful concern gave up its very large interests in the Norwegian oxidation processes upon the perfection of the Haber method and is said also to have forced German by-product ammonia producers to turn over to itself an even share of the German ammonia market.

Conclusions.—The above brief outline regarding the status of the principal methods of obtaining nitrogen compounds from the air shows conclusively that this whole question has reached a point where its industrial future must be considered assured. It remains, therefore, for the purposes of the present discussion, to determine as definitely as possible the course to be followed by this industry should it be established at The Dalles in order that it might operate most advantageously.

All available evidence, it would seem, indicates that the plan of necessity would be to manufacture ammonium nitrate by the use of one of the nitrogen oxidation processes combined with either the Haber or cyanamid process of making ammonia. The arguments, in brief, are as follows:

A minimum amount of heavy raw material would be needed.

There would be utilized the maximum amount of the cheapest raw material available at The Dalles, namely, power.

The product would contain more available nitrogen than any other compound that could be made, pound for pound, at anything like comparable cost and therefore to a greater extent than any other substance could stand transportation into the markets of the world.

More than any other substance might it command a premium in price because of its manifold uses. It can be used as fertilizer, as safety explosive, as a source of nitric acid, or as a source of ammonia.

As to its probable cost of manufacture it can be stated that based upon the costs of nitric acid and ammonia derived in the discussions which have preceded this should be in the neighborhood of \$50 per ton. The demand for the product should be unlimited.

REPORT OF N. E. L. A. ELECTRIC RANGE COMMITTEE.

Electric cooking has been demonstrated to be successful and should be pushed by a large majority of central stations. This report deals with some of the problems involved in rapidly developing electric cooking.

Advertising.—National advertising campaigns in publications that reach the housewife should be vigorously pushed; these should be supplemented by special advertising on the part of the central stations.

Merchandising problems and co-operation with manufacturers.—Fairly satisfactory types of electric ranges are on the market; the central station, at the start, at least, will have to push the sale of ranges. It is absolutely necessary for the manufacturers and the central stations to co-operate on questions of design, construction and the merchandising of electric ranges.

Electric cooking and water heating rates.—Each central station will have to adopt the form of rate which adapts itself to its existing rates. Household cooking and baking in restaurants, bake shops, etc., can be profitably handled on a 3 cent rate; cooking in hotels, etc., requires a somewhat lower rate; water heating requires a rate of one cent per kw.-hr. or less.

Water heating.—Central stations must prepare to heat water electrically for a considerable portion of their electric cooking customers; present types of electric water heaters are efficient; storage of hot water is generally very inefficient; a beginning only has been made in the solution of the water heating problem.

Introduction.

Electricity has been sold for cooking purposes by central stations in this country for over sixteen years; however, but little development in electric cooking has occurred until the last five years; the remarkable growth of and interest in electric cooking during this period is but a beginning for, with many of the central stations who have been most active in developing this load, the gross earnings received from this source are less than one-half of one per cent of their total gross earnings.

But few of the housewives have any conception of the advantages of cooking with electricity; the large majority of central station men are skeptical as to its feasibility from the consumer's point of view, as well as that of the company.

Yet the very considerable load that has been obtained by central stations actively developing electric cooking, on the European Continent, in many tropical countries, in Canada and in many places in the United States; the fact that electric range business of many manufacturers has increased thirty fold during the past five years and the more than doubling, this year, of the number of concerns making electric ranges, causes all central station men to devote a great deal of thought to this question.

The electric range report presented at the Portland Convention of the Northwest Electric Light & Power Association last fall, was intended to furnish such information as could be hurriedly collected to enable the investigator of this question to determine:

1st. Is electric cooking practical from the housewife's point of view.

2nd. Is the cooking load a desirable load for the central station.

(a) From the point of view of the investment required.

(b) From the point of view of the operating cost.

(c) From the point of view of the earnings.

The committee appointed for the purpose of presenting this report assumes that the advisability of electric cooking, as far as the central station is concerned, has been settled by a constantly increasing number of central stations in the affirmative, and therefore devote our study and report to the problem involved in the development of the use of the electric range by our customers.

Advertising.

Your committee advances the following conditions as a basis of facts on which to discuss the advertising requirements of the electric range situation; and in setting forth the following premises, it is your committee's conviction that in the field of advertising lies one of the most promising opportunities for effective work on electric range cooking.

Contemplation of improvements in the advertising of electric range cooking seems to your committee to be predicated on the following present conditions:

1. That no established, fixed, or positive demand exists at present on the part of the public for electric ranges.
2. That the actual marketing of electric ranges (the placing of ranges in homes) is being accomplished as the sole result of strenuous and insistent sales efforts by central stations.
3. That so devoid of manufacturers' advertisements on electric ranges and electric range cooking have papers, magazines, and other advertising media been, that not one woman in a thousand can name, off-hand, a reputable make of electric range.
4. That to date electric range cooking is still shrouded in mystery of operation, uncertainty as to results and costs; despite the vigorous efforts made by central stations lately to draw aside the curtains and let in the light and truth on electric range cooking.
5. That the great majority of new homes and apartment houses are still being built without wiring installed for electric ranges.
6. That not only is the burden of marketing electric ranges being borne by central stations, but that central stations are, in addition, bearing the burden of introducing, guaranteeing and familiarizing the public with the various makes of electric ranges,—an obligation that clearly should have been met in the past, and should be met in the future by the manufacturers of the ranges.
7. That it is now true that the experimental stage in the construction of electric ranges is largely past; that central stations have established rates permitting economical electric cooking, and there is a sufficient variety of types and styles of electric ranges on the market to meet requirements; that electric water heating devices are being developed

to a point where they promise to be efficient and economical.

With these things in mind, then as visualizing the present marketing conditions as your committee sees them, your committee respectfully submits the following recommendations:

A national advertising campaign in newspapers and weekly and monthly periodicals is urgently needed. This campaign should be carried on by the electric range manufacturers, either collectively or individually, and its purpose should be to drive home to housewives throughout the entire country the success of electric range cooking; its economy and its many advantages and possibilities and conveniences. Your committee feels that in all probability the electric range is today the only commodity or utensil in use, or which it is possible to use in modern kitchens, that has not been made the subject of strong, direct-to-consumer advertising campaigns, national in scope. Your committee believes that housewives have been taught to look for the manufacturer's message and guarantee on the appliances for use in the kitchen, and that therefore, electric range manufacturers are putting too heavy a burden on central stations in permitting the latter not only to introduce and foster electric range cooking to the housewife, but in advertising the electric ranges themselves and their various advantages and points.

Today the housewife who knows anything about an electric range knows it only by virtue of what she has learned from the central station salesman, or central station advertising.

Let the manufacturers of electric ranges follow along these lines—either individually or collectively—and spend comparatively small sums each year in newspapers and magazines and other various media reaching housewives, and your committee is convinced that such a move would instantly take its place as a fundamental element in the greatly increased use of electric ranges.

It occurs to your committee that inasmuch as the Society for Electrical Development is supported to a large extent by electric range manufacturers, that an advertising appropriation could be set aside by the society to be devoted to a national campaign furthering electric range cooking along educational lines.

The advertising campaigns of the individual manufacturers should tie up to the society's campaign in the nature of copy, etc.

Your committee believes that the advertising done by either the society or the electric range manufacturers, or both, should give emphasis to the following points:

1. That the elementary experimental stage of electric range cooking has long since passed.
2. That the age of electric cooking has not only arrived, but that it now occupies an impregnable stronghold in the homes of thousands of women.
3. That there are fixed standards in the manufacturing of electric ranges, to which all reputable manufacturers adhere—and this forms the housewife's protection in (1) adopting electric range cooking and (2) in selecting the make of range that most appeals to her.
4. Then drive home the general advantages of electric range cooking—cleanliness, economy, safety,

added personal comfort, and all the other points that make for superiority in electric cooking over all other forms.

And on this foundation of manufacturers' publicity and advertising, may then be reared a superstructure of proper and adequate and effective co-operation in the supplementary advertising that will have to be done by both manufacturers and the central stations.

Then, too, will the central station be able to take its proper place in the scheme of marketing electric ranges and exercise its natural function of helping the housewife to select the size and type of electric range best suited to her individual needs; of helping and aiding her in the operation of the electric range; and in keeping the range on its lines year after year, while each such range by its own success and word of mouth advertising, will sell other ranges.

Your committee believes that special literature should be available for the use of central stations in their efforts to interest domestic science and home economics departments of public schools, colleges, and similar institutions in electric cooking.

Your committee suggests further that special literature be prepared for architects and builders so that they may have data upon which to recommend electric cooking to their clients and provide for range and water heating wiring in all new and remodeled residences and apartment buildings.

Your committee believes it would be a good thing to have an electric cook-book prepared for distribution by central stations; this book to contain information on the principles of electric cooking, on economical methods of using the electric range, and on methods of preparing and cooking articles of food on the electric range.

Your committee believes that the following will be of additional benefit in the advertising campaign:

The use of a national slogan, such as "Cook by Wire," in all advertisements and literature dealing with electric cooking.

Billboard posters featuring "Cook by Wire" slogan, lithographs of electric range in use, with educational reading matter.

Readers and articles on electric cooking to be circularized among newspapers and periodicals.

Pamphlets on electric cooking, embodying the ideas used in newspaper and periodical advertising. Such pamphlets should contain educational reading matter, attractive cuts, and useful information about electric cooking, and should be distributed by central stations among their consumers.

Form letters and postals with human interest for "Direct to Consumer" advertising by central stations.

Cuts, literature and display copy for use in local newspaper advertising. In case the central station handles more than one make of range, it is desirable that this material should be neutral in character insofar as competitive range features are concerned.

Manufacturers' pamphlets or catalogues to be distributed by central stations, containing educational reading matter, illustrations, descriptions and prices.

Manufacturers' booklets containing effective testimonials and illustrations.

Electric range cooking demonstrations in connection with local newspaper advertising.

(To be continued.)

MUNICIPAL OWNERSHIP OF RAILWAYS AT SAN FRANCISCO.

BY JOHN KENDRICK BANGS.¹

A recent issue of a magazine devoted to the literature of exposure contains an entertaining article by a prominent socialist on "The Common Good vs. Private Greed," in which its accomplished author paints a most alluring picture of the success of the municipal railways of San Francisco and the sad failure of the United Railways of that same favored city. It is indeed a glowing account of conditions alleged to exist in California, where everything fructifies in such lush profusion that it is scarcely any wonder that in the year of grace 1915—Exposition year, by the way, with millions of extra consumers of its product—even a municipally owned railway should show fruit large enough almost to be accounted a "melon."

The author of the article in question is a man of great enthusiasm and sincerely devoted to the causes he represents, and it is therefore not so very surprising that, in the exuberance of that joyous moment when he has at last discovered one municipally owned tramway in America, which, in one year, under extraordinary conditions, has actually proven a paying proposition, he should dwell almost wholly upon the alluring side of the picture.

That he should perceive only the roses of municipal ownership and the thorns of private greed is possibly quite to be expected considering the visual peculiarities of the municipally owned eye; and just as some foreign critics of American manners contrast unfavorably to ourselves the deportment of American hucksters and yokels with that of the British aristocracy, the French noblesse, or the mediatized families of the Teutonic powers, so does this ardent commentator contrast the worst aspects of private ownership with the supreme virtues of the municipal enterprise.

He speaks feelingly, for instance, of the greater courtesy of the municipal employes. But it has been our good fortune recently to visit San Francisco, and it has pleased us to test his inferences by personal experience, and we are glad to be able to report that in respect to the Chesterfieldian qualities of the public servants of the rival lines there is no perceptible difference. He speaks of the filthy cars of private ownership, and intimates a glorious cleaning-day freshness about the rolling-stock of the city. But, again, we have travelled on both and we venture the statement with a positiveness born of personal observation that only a nose devoted professionally to the discovery of smells could possibly sense any inferiority on either side.

The author states, in respect to "road-bed and track," that that of the private companies is "largely punk," while that of the municipal lines is "the best obtainable construction throughout," of which statement we can only smilingly say that in point of accuracy it is remarkably like the popular Boston jest, which our esteemed friends of the Boston Transcript print about once a week, that New York is a horse-car city because somewhere down-town in the metropolis, for the preservation of certain charter rights, there is a joyous relic of other days being hauled daily to and fro across town by one, or maybe two, ancient nags.

As to equipment, this historian has also to say that the United Railways have "some large, dirty cars some Noah's Arks," while the M. O. cars are "the best, newest, and most efficient," another delightful specimen of the reserve of statement by these bifocal observers of modern conditions who gaze upward through rose-colored glasses and glance downward through lenses of murky yellow.

But in connection with this point, even if one were inclined to grant the truth of the criticism, it is a fact, of which the author does not seem to be aware, and one which we fear the citizens of San Francisco themselves are not yet aware of, that when the municipally owned venture started in, its sponsors actually borrowed from the privately owned companies the plans and specifications upon the lines of which the present municipally owned palace-cars were built, and used them without pay, for their own good purposes!

Another point advanced by this engaging writer has to do with the relative cost of the administration of the business of these two competing lines. He shows us that the private company employs an imposing staff of salaried officials to conduct its business, while the municipal company has but one executive employe, a superintendent, who is paid \$5000 a year.

Of course the "Board of Public Works of San Francisco," which takes general care of the municipal railway, devotes its unremitting attention and service to the great work gratis; and the city attorney and his assistants, who look after its legal business, derive all their pay from pretty little personally owned vineyards and orchards in the fructiferous outskirts of this garden city of the world; and the employes of the other city departments, who in one way or another have to sit up nights to boost the city's pet enterprise to loftier levels, is made up of self-sacrificing altruists who would scorn, as corrupting, the offer of any pay for their services beyond the kind words of a grateful public.

Consequently, barring that \$5000 superintendent, there are absolutely no overhead charges to drain the pockets of the tax-payers, which makes it all the more remarkable, in our view, that the cost of a ride on the municipally owned lines is precisely the same as that upon the corrupted lines of rust operated by old Brother Greed!

This all constitutes a beautiful picture of self-sacrifice, the contemplation of which fills us with admiring wonder. Of course we are not let into the secret of how it has all been brought about.

We are not told how, when the duly appointed protectors of certain definitely assured rights have turned on their persecutors and have said, "Your acts are unlawful," and have proven the illegality of those acts in the courts, these upholders and makers of law have deliberately flouted the courts, consigned them to a balmier climate than that of the San Joaquin Valley and treated their decrees with contempt. And then, when brought to book, have secured from the state legislature full authority to continue to defy the law and repudiate their expressed written obligations.

Meanwhile the highest fiscal official of the state of California, Controller John S. Chambers, within

¹In "Concerning Municipal Ownership."

the past few weeks, has officially announced that the increase of taxation in the state has been at the rate of 33 1/3 per cent faster than the increase of taxable property, and he has issued to the public the following impressive warning:

The totals of our receipts and expenditures are huge and the percentages of increase alarming. As our population grows and our governmental problems multiply, the legitimate cost of government will go up. But we should put the brakes on. Even legitimate expenditures can be held down or postponed. How long can we stand the present state of affairs? Should the present rate of increase continue, the burden will soon become unbearable. We vote away millions of dollars with scarcely a thought to the future. The bonds will run anywhere from fifteen to forty years longer, with the bulk of the principal and interest to be paid by our children and our children's children. But I protest not only in the name of posterity, but in the name of the taxpayers of the present day. The burden is already too heavy. It is time to stop and think.

In support of this warning the controller notes that in the past five years the bonded debt of the state has increased 457 per cent, that of the counties 308 per cent, and that of the cities 98.6 per cent, "with large amounts of bonds authorized but not yet sold." He implies that, computed at 4 per cent, which is below the rate paid by political subdivisions of the state, the interest on the total debt of the state and its subdivisions for 1915 was \$10,113,500, or approximately the total cost of running the state government five years ago, before, to quote a resident of San Francisco, California, "started on its present orgy of debt and taxation."

LECTURE COURSE IN ILLUMINATING ENGINEERING.

The Illuminating Engineering Society has arranged for a series of lectures to be given at the University of Pennsylvania this fall. These will differ in scope from those given at John Hopkins University in 1910 in that it will deal more with the application of principles than developed.

The present series of lectures ought to be of direct and great importance in inculcating the appropriate and wise use of illuminating appliances, and should be therefore especially valuable to those who are dealing directly with the problem. The theoretical side of illuminating engineering will not be neglected, but to increase its practical usefulness to the public is a fundamental purpose of the course.

Preliminary List of Subjects for I. E. S.-U. of P. Lectures.

Subject.	Number of Lectures.
(A) General.	
(1) The Principles of Interior Illumination.....	2
(2) The Principles of Exterior Illumination.....	1
(3) Color in Lighting.....	1
(4) Architectural and Decorative Aspects of Lighting.....	1
(5) Recent Developments in Electric Lighting Appliances.....	1
(6) Recent Developments in Gas Lighting Appliances.....	1
(7) Modern Lighting Accessories.....	1
(B) Special Lectures on Interior Illumination.	
(8) The Lighting of Factories, Mills and Workshops.....	1
(9) The Lighting of Offices, Stores and Show Windows.....	1
(10) The Lighting of Schools, Auditoriums and Libraries.....	1
(11) The Lighting of Churches.....	1
(12) Theatre Lighting (including Stage Lighting) and the Lighting of Art Museums.....	1
(13) The Lighting of the Home.....	1
(14) Train Lighting.....	1
(C) Special Lectures on Exterior Illumination.	
(15) Street Lighting.....	2
(16) The Lighting of Yards, Docks and other outside works.....	1
(17) Headlights, Searchlights and Projectors.....	1
(18) Sign Lighting.....	1
(19) Building Exterior, Exposition and Pageant Lighting.....	1

HAZARDS OF ELECTRIC HEATERS AND RANGES.

BY G. A. CLEARY.

(This timely information regarding precautions to be observed in the installation of electric ranges should be of interest to every electrical contractor and central station. The author is electrical inspector with the Board of Fire Underwriters at San Francisco.—The Editor.)

The utilization of electric current through the medium of resistance devices for cooking and heating is fast assuming proportions not thought of a short time back. This undoubtedly introduces hazards, both fire and physical, which should be intelligently dealt with. While the life hazard is of secondary concern, the hazard from fire is of vital concern to the underwriting interests.

As with every device that sooner or later will be widely used, obstacles must not be placed in the path of the ultimate user, so as to cause hesitancy. Reasonable restrictions as to the method of connecting electric ranges and water heaters are made to safeguard the risk from fire and the accidental contact of the person using the appliance with exposed live metal parts.

From the viewpoint of safety to life, an enclosed rotary switch is unquestionably superior to the knife blade switch. Housewives object to the use of knife blade switches in cabinets, on the grounds of unsightliness, one energetic manager going so far as to white enamel the cabinet to meet this objection. Of course where the range and water heater are connected so as to preclude their simultaneous operation, the knife blade type of switch must be resorted to.

All ranges should be permanently and effectively grounded. Lugs are now provided on most makes of ranges for this purpose. This is a detail involving little expense, as it only requires that a jumper be placed from the conduit feeding the range to the body of the range itself. The matter of grounding should concern the installer of every electric range, for if the untechnical individuals who inhabit most of our homes find that they are liable to shock, the news will travel quickly and incidentally cause the energetic salesman more worry in overcoming the prejudice of the probable user.

From an insurance viewpoint, an installation of electric ranges introduces little fire hazard where the regulations of the National Electric Code have been complied with. On the other hand, it has been felt that electric ranges properly installed are so preferable to coal or gas ranges, with attendant hazard of ashes, matches and open flame, that any unwarranted obstacles should not be put in the way of their development and use.

The Code treats the range as a complete unit, irrespective of the number of plates or ovens, and requires switches and cut-outs accordingly. Disregarding the switches mounted on the range and the fusing of the individual elements on certain makes, an indicating switch or plug connector and cut-out must be provided to disconnect and protect all wires of the circuit supplying the range.

Opinion differs as to the advisability of fusing of the individual elements; manufacturers such as the General Electric Company and Hughes Electric Com-

pany, make a practice of fusing separately; while the Hotpoint, Westinghouse, Simplex, etc., rely on the feed wires to the range for the required protection.

The question of fusing electric ranges is one most frequently asked, so that information on this point may be of interest. The matter of separate fuses for the units of electric ranges came up a number of years ago when some of the first appliances of this character were submitted to the Underwriters' Laboratories for examination and test. At that time there was considerable discussion on this question, and it was finally decided that it was not necessary to insist upon separate fusing in such construction. This opinion has later been confirmed in the examination and report of ranges of several manufacturers.

It was felt that the use of separate fuses for each unit would require quite a number of these fuses, which must be mounted in a wall cabinet separate from the range or mounted on the range itself. In the former case, the use of such subdivisions of circuits through fuses required a multiplicity of leads from the separate panelboard to the range, and a further complication of the range wiring itself. This is considered a disadvantage and unnecessary.

On the other hand, the location of the fuses on the range itself is undesirable because of the complication in the wiring resulting, and because of the possible improper relation of the fuses when subjected to the heat of the hot parts of the range itself. This question involves further complication in view of the fact that certain ovens are provided with plug fuses where the oven is designed to operate on a voltage that exceeds the voltage rating for Edison plug fuses.

Such ranges as are listed as standard are composed of non-combustible material and have substantial heater units fixed in position relative to each other and to the range as a whole. The wiring is of some flame-proof character, and the runs from the main distribution panel or switches on the range are short and well protected. A burnout, either in one of the units or in any of the connected wiring within the range, may reasonably well be depended upon to open the circuit, or that part of it which is in trouble, without producing conditions within the range which are themselves hazardous. It has furthermore been felt that from the practical point of view, it was probably desirable that the user should be called on to keep one and only one set of fuses, and these in the mains; rather than to maintain under somewhat difficult conditions existing in this character of service, a number of smaller fuses which require to be chosen with considerable skill in order to operate satisfactorily under working conditions.

Furthermore, very strong protests were received from manufacturers of ranges against requiring the sub-fusing, it having been felt, as above mentioned, that electric ranges afforded, from an Underwriter's viewpoint, a superior installation.

Water heaters utilizing the water as the conducting medium between the electrodes are not looked upon with favor, while in the case of the resistance unit type, the design anticipates the dissipation of the heat as generated, and they therefore present a fire hazard when used in receptacles where, in the event of failure of the water supply, while the heater is turned "on," the casing rapidly attains a high tem-

perature, sufficient to ignite combustible material. But the probabilities of obtaining this condition in service are considered remote, and with normal operation these heater provide a relatively safe and ready means of heating water. In the former case, the resistance medium being in contact with the water, will permit a leakage of current to ground to an amount dependent upon the resistance of the water, between the resistance element and the metal casing of the water chamber. With water of ordinary purity, this leakage will be negligible. The hazard, both fire and life, in a device of this character is self evident.

Likewise, a device employing exposed luminous resistance element is hardly to be considered the equivalent of a unit that has the resistance wire adequately protected.

In conclusion, it might be mentioned that to recognize the fire and life hazard in electric ranges and water heaters, feed wires of the proper capacity should be selected; the use of approved switches to be located within sight of the range; fuses of the proper capacity to be installed in the circuit; ranges to be grounded; and lastly and most important the selection of an appliance that will stand up under a reasonable amount of hard usage and one that contains no apparent defect that might hinder its continued operation.

RAILWAY EQUIPMENT REQUIRED FOR MOVEMENT OF MILITARY UNITS AT WAR STRENGTH.

In view of the nation-wide interest in preparedness, there is printed below a table giving an idea of the amount of railway equipment that would be required in the event of mobilization and movement of various military units. The figures were obtained from the War Department by J. E. Baker of the Southern Pacific Company:

	Officers.	Men.	Animals.	Vehicles.	Guns, Complete.	Pullman.	Coaches.	Baggage.	Box.	Stock.	Flat or Gondola.	Total Cars.	Trackage (Feet).
	Personnel			Railroad Equipment Required									
Infantry Regiment.....	55	1890	177	22	..	5	43	5	15	9	8	85	5150
Cavalry Regiment.....	54	1284	1438	26	..	8	28	8	25	72	9	150	7850
Artillery Regiment, Light.....	45	1170	1157	32	24	9	23	9	25	58	46	170	8675
Artillery Regiment, Horse.....	45	1173	1571	35	24	10	24	10	25	78	47	194	9830
Artillery Regiment, Mountain.....	45	1150	1229	..	24	7	23	7	30	61	..	124	6405
Engineers, Pioneer, Battalion.....	16	502	165	12	..	2	12	2	10	8	4	38	2110
Signal Corps Field Battalion.....	9	171	206	15	..	2	4	2	5	10	5	28	1460
Infantry Division, comprising:													
3 Brigades Infantry,													
1 Regiment Cavalry,													
1 Brigade Light Arty.													
1 Pioneer Engr.,													
1 Field Battalion,													
Signal Corps,													
and necessary													
wagon trains.....	736	22285	7660	775	48	46	487	45	245	383	301	1507	82265
Cavalry Division, comprising:													
3 Brigades Cavalry,													
1 Regt. Horse Arty.,													
1 Pioneer Engr.,													
1 Signal Corps													
Battalion,													
and necessary													
wagon trains.....	458	10259	12231	414	24	63	218	63	210	611	137	1302	77190

To move a Field Army would require: 2115 passenger cars; 385 baggage cars; 1055 box cars; 1899 stock cars; 775 flat cars; total 6220 cars, which make about 366 trains, and require this number of locomotives.

JOURNAL OF ELECTRICITY

POWER AND GAS

FOUNDED 1887

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NOTICE TO ADVERTISERS.

Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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A Dog was lying upon a stall full of hay. An Ox, being hungry, came near and offered to eat of the hay. And the ill-natured Cur, getting up and snarling at him, would not suffer him to touch it. Upon which the Ox, in the bitterness of his heart, said, A curse light upon thee for a malicious wretch, who will nether eat hay thyself, nor suffer others to do it. Aesop.

An Ancient Fable—

There are cities, perilously close to the limit of their bonded indebtedness and sadly lacking in schools, sewers, parks, police and fire protection, which propose to supply some favored citizens with street-car transportation, electricity and telephone service in competition with existing private utilities. The latter are giving good service, are paying taxes on heavy investments and are closely regulated as to rates. Yet because the politicians in the cities perceive an opportunity to build up a machine for patronage, they wilfully mislead their deluded followers into the folly of municipal ownership of public utilities.

That Seattle's municipal lighting plant cost taxpayers over one hundred thousand dollars last year because commercial service has been given at less than cost, and municipal lighting charged an exorbitant rate, was demonstrated in these columns three weeks ago. That Cleveland's municipal lighting plant is being conducted at a loss was pointed out in the same issue. San Francisco's subterfuges in accounting are detailed in this issue, and to this may be added the fact that the taxes in that city today are more than double those twelve years ago.

Notwithstanding these examples of what not to do, in spite of numerous disastrous experiences in the political operation of technical utilities, the citizens of Los Angeles, every bread-winner of whom is already paying an average tax of six dollars per month, now propose to further mortgage themselves in order to duplicate existing electric distribution lines. At this date there is pending before the California Railroad Commission an application on the part of the city to take over the business of one of the big distributing companies without due severance damage occasioned by cutting out the main outlet for power generated. Even if the company should be willing to sell its business in the City of Los Angeles, it should at least be for a fair compensation. In June, also the people of Los Angeles are to vote on the matter of issuing bonds to take over a telephone system.

As is well known, these several instances are merely typical of what is being done throughout the entire West, which is more or less of a laboratory for many socialistic experiments. Some few of these experiments may prove successful and be adopted into universal usage. But municipal ownership of public utilities as yet has been a dismal failure in most places largely because dependent upon political patronage for its perpetuation. Commission regulation of utilities is the mean between private and municipal ownership

and operation. It should at least be given a fair trial before going to the extreme of municipal ownership.

The evil to which attention is to be specifically directed is unregulated municipal competition with regulated private utilities. Private utilities are subjected to commission control, they cannot invade the territory satisfactorily served by existing companies and they pay heavy municipal and state taxes which contribute largely toward paying the expenses of government. Municipal utilities are exempt from all these requirements.

As a matter of fact, a modern city cannot expect adequately to care for all the legitimate matters requiring public funds and also enter into the business of supplying the inhabitants with telephone, street railway, gas and electric service. These latter utilities require large capital and involve some financial risk which a city should not be called upon to assume. Yet when they are operated to supply part of a community at the expense of the whole they create a condition with which private capital will refuse to cope.

So it is seen that municipalities are unable to give a complete technical utility service, they deter private enterprise by competition in favored districts and thus enact the part of the dog in the manger. Is it any wonder that the investor says "a curse upon thee" and departs to fields offering superior inducements?

Individuality is the target at which the electrical dealer should aim. It is the key that unlocks the door to success in modern retail selling. Every sales effort should be subordinated to and directed toward attainment of store individuality, as it is the secret of successful electrical merchandizing.

Store individuality is almost as hard to define as it is to acquire. It is more elusive than personality, for a store's individuality is largely a reflection of the owner's personality. It is like a person's good name.—priceless. It consists in being different, and while being different, being better. Doing things differently and doing things better are the duality that make for individuality.

Thus the individuality of a store is the aggregate of those things which make it a desirable place to do business, as compared with some other store. An electric shop is better than a department store as a place to buy electrical devices, because it specializes in their sale, gives trustworthy advice on their installation and offers a more judicious selection. It is different.

One of these "different" electric shops is better than another "different" electric shop because of any one or all of a number of reasons. Clerks are more polite, goods are more cheerfully and promptly exchanged, values are more as represented, or it is a more attractive place to buy because cleaner and lighter. It is this "moreness" in service that gives desirable individuality. It comes from not only "making good," but making better.

But what is the use of aiming at the target unless you hit the bull's-eye. The bull's-eye of individuality

is the reputation for doing things differently and better,—renown for service. Profit from individuality comes only from public knowledge of it. Publicity must be given as to how the store is different and better if the store is to be characterized as a desirable place to do business, if an increasing volume of trade is to be developed, and if that trade is to be rendered permanent.

The expensive burden of creating the demand for electrical goods has been assumed by the manufacturer, so that it is merely necessary for the dealer to tie in locally with the national advertising. This can be done by proper display within the store, by dressing the windows well and changing them frequently, and by adequate window lighting at night. Some measure of publicity can be secured by enclosing advertising matter in packages as they are wrapped and by mailing literature to selected lists. And by all means the dealer should advertise things of news interest in the newspapers.

The electrical dealer has an advantage in newspaper advertising possessed by few other lines of trade. Electricity is interesting to the public and there is always something new to talk about. These elements are the essence of success in advertising and should be capitalized. Such advertising should be steady. It takes repetition to build reputation.

Manufacturers and jobbers are co-operating actively with dealers in the way of good advertising copy, store display and window dressing. These 'dealers' helps represent the best thought of some of the country's highest priced advertising men. A dealer is overlooking a good opportunity if he does not employ them to work for him. It is the manufacturer's part to create interest in the goods and the dealer's part to create interest in his store as the place to buy the goods. It is only through the dealer that the psychological reaction produced by advertising can be converted into real sales.

The most important factor in this problem of establishing a paying electrical retail business has been left to the end. After developing store individuality, after bringing people to the store and after making an attractive store, the final sale and the likelihood for future business is made or marred by the clerk. He should be well trained, well informed about the merchandise, courteous and filled with the ideal of service. The salesman, like the hands of a watch, is the customer's index as to the working of the organization.

Consequently sales people should be taught the selling argument that induced the manager to buy the goods, they should be impressed with the effect their tact has on the good will of the house, and they should understand the ways in which they can help the purchaser.

Summing up, the manager should put his enthusiasm, his knowledge, his ability, and himself into every branch of his business, thereby inspiring his assistants, his customers and the public with his own personality and thus gradually building up for his store a reputation for individuality.

PERSONALS

H. S. Title of the H. S. Title Company, will return to San Francisco from New Mexico next week.

Clarence Dunbar, purchasing agent Western States Gas & Electric Company of Stockton, was at San Francisco this week.

R. F. Eehan, Westinghouse Electric & Manufacturing Company, has returned to San Francisco from the San Joaquin Valley.

R. H. Coyne, Pacific Coast manager of the Kellogg Switchboard & Supply Company, has returned to San Francisco from Los Angeles.

H. V. Carter, president Pacific States Electric Company, is attending the meeting of the electrical supply jobbers at Hot Springs, Va.

Howard Shield, formerly with the Electric Appliance Company, is now traveling out of Salt Lake City for the Capitol Electric Company of that city.

J. C. Clankinton, manager of the Hilo Electric Light Company, Limited, Hilo, Hawaii, was in San Francisco last week and left for the East on important business.

H. D. Pillsbury, vice-president, and **J. C. Nowell**, general manager of the Pacific Telephone & Telegraph Company at San Francisco, are making an extended trip East.

Ralph Elsmen has resigned as engineer with the Pacific Gas & Electric Company, to act as underground engineer for the Electric Bond & Share Company at New York City.

H. G. Levy of the Electric Manufacturing Company, has returned to San Francisco from a trip to San Diego and back by auto. His running time on the return trip was eighteen hours.

C. C. Hillis, general manager of the Electric Appliance Company, San Francisco, was at Del Monte last week attending the convention of the Automobile Accessory Jobbers' Association.

Walter Smith, formerly with Holabird-Reynolds Electric Company, and recently with J. C. Hobrecht of Sacramento, is now in the San Francisco sales department of the Electric Appliance Company.

Samuel H. Taylor, president of the Electric Railway & Manufacturers' Supply Company, left May 27th for Hot Springs, Va., to attend the semi-annual meeting of the Westinghouse Agent-Jobbers' Association, which meets there on June 1-2-3.

S. B. Gregory, Pacific Coast manager of the Arrow Electric Company; **John Rendler**, president of the Southern California Electric Company, and **Allen Smith**, sales manager of Holabird-Reynolds Electric Company, have returned to Los Angeles from a four days' fishing trip at Big Bear Lake.

J. Ed. Erickson, formerly with Condit Electrical Manufacturing Company of Boston and later with Western Electrical Company at Cleveland, has joined the sales organization of The Packard Electric Company of Warren, Ohio, and will cover the territory formerly in charge of Mr. Benj. Smith, who retires.

W. J. Davis, Jr., Pacific Coast engineer General Electric Company; **W. G. B. Euler**, superintendent of operation Great Western Power Company, and **C. A. Turner**, plant engineer's office Pacific Telephone & Telegraph Company, have been elected as new members of the executive committee, San Francisco Section American Institute of Electrical Engineers.

L. H. Newbert, **Leon Jones**, **Van E. Britton**, **F. S. Myrtle**, and **M. L. Nealy**, manager of the Fresno office, all of the Pacific Gas & Electric Company, were present at the Pacific Coast Gas Association dinner at Los Angeles on May 20th. **Frank A. Cressey**, manager of the Modesto office of the Pacific Gas & Electric, acted as presiding officer at the dinner. There were 125 present.

MEETING NOTICES.

Technical Societies of Los Angeles.

A joint meeting of the technical societies of Los Angeles was held Thursday evening, June 1st. The subject of the evening was "Preparedness." A. H. Koebig presided, and George A. Damon officiated as toastmaster. The following speakers talked on the various phases of "Preparedness": George W. Dickie of San Francisco, associate member of the Naval Consulting Board; W. H. Booth, vice-president Security National Bank; Earle Remington, president Aeronautical Society; Captain Richard Park of the U. S. Army; Captain Charles T. Leeds of the U. S. Army (retired).

San Francisco Electrical Development and Jovian League.

In the absence of President Cutting, Vice-President Hillis, and all but one member of the executive committee, who put in a belated appearance, the May 24th luncheon was ably handled by a volunteer group with T. E. Collins presiding. Incidentally, this was made the occasion for a little extemporaneous fun. Announcement was also made that a unique outdoor Jovian Rejuvenation would be held under the joint auspices of the San Francisco and Oakland Jovians at Trestle Glen, Oakland, June 10, 1916. Great preparations are being made to insure that this will be the most spectacular rejuvenation ever held locally, a number of special illumination features being contemplated. Mr. A. C. Rulofson, president of the Home Industry League, was then introduced and gave a graphic illustration of the benefits which would accrue from more united support of this movement. He also spoke briefly of the evils that would be entailed by the proposed prohibition measure.

California Association of Electrical Contractors and Dealers.

The regular monthly meeting was held Thursday evening, May 25th, at Oakland. L. B. Gilpin acted as chairman of the evening, introducing C. L. Chamblin, who spoke on the subject of "Credit," and made a plea for shorter credit terms, saying in part that extended terms of credit meant loss and increased overhead to the dealer and contractor. M. L. Scohey presented some remarks on the "Outlook from the Dealers' Standpoint," and urged the adoption of a more reasonable and sensible margin of profit for dealers. C. F. Butte, president of the San Francisco section, presented a most interesting and detailed report of the accomplishments and doings of the San Francisco section. H. C. Reid spoke of the accomplishments and benefits derived from association work and the lessons of co-operation taught. W. L. Goodwin of the Pacific States Electric Company, and A. Youngholm of the Electric Railway & Manufacturers' Supply Company, presented some practical illustrations on methods of profit figuring and cost estimating, which proved of great interest. Among other speakers of the evening were Robert King, Oakland, Frank Somers, San Jose, C. O. Gould and A. F. Flanagan, Stockton. The meeting proved to be one of the most enthusiastic in the association's history and a surprise which added to the hearty goodfellowship of meeting was the appearance of fourteen representatives of the electrical industry who had toured from Stockton by automobile for the purpose of demonstrating that they were alive to the electrical situation and even went further by announcing through their spokesman L. F. Youdall, they wanted the annual convention of the state association held at Stockton. To back up their claim they presented a most cordial invitation from the Chamber of Commerce of that city. The visitors were heartily cheered and the meeting by unanimous vote decided that the convention to be held this coming July should take place in the city of Stockton. The Stockton delegation was made up of the following members: B. Van Cott, L. F. Youdall, A. F. Flanagan, Wm. Murphy, C. O. Gould, H. S. White, R. Gould, D. G. Johns, C. D. Bass, C. Stanley, C. Frankie, F. Lyman, W. L. Hild, Geo. Tiffany.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The commission has authorized the Pomona Valley Telephone & Telegraph Union to use the proceeds from the sale of \$60,000 six per cent bonds in retiring \$28,475.12 of notes, \$2000 of bonds, and balance for construction of office building costing approximately \$25,000.

The commission has authorized the Martinez and Concord Interurban Railway Company to issue securities preliminary to constructing a line from Martinez to Concord, in Contra Costa county. The company is also authorized to issue \$125,000 first mortgage bonds to be sold at 90 per cent of face value, and \$125,000 cumulative participating bonds.

The Commission has authorized the Modesto Interurban Railway to issue \$12,423.32 of promissory notes, payable to Union Savings Bank of Modesto and T. K. Beard, and to mortgage its property for \$4000 to pay T. K. Beard for moneys advanced. Union Savings Bank of Modesto is to hold the mortgage.

The commission has authorized the Modesto Gas Company to issue and sell \$65,000 bonds, at not less than 90, the Modesto Gas, Light, Coal & Coke Company to transfer all its property to the Modesto Gas Company for 995 shares of that company's stock, and the assumption by it of all the liabilities of the selling company. The bonds are 30-year, six per cent.

The commission has issued an order authorizing the Mt. Whitney Power & Electric Company to issue \$450,000 face value of its first mortgage 6 per cent bonds under its deed of trust to the Bankers Trust Company of New York.

The commission has authorized the Martinez & Concord Interurban Railway Company to issue 600 shares of its stock, to be sold at not less than \$80 per share; also 100 shares to Clifford McClellan and J. B. Rogers to reimburse them for expenditures in organizing company. The company is also permitted to issue \$125,000 first mortgage bonds, to be sold at not less than 90, and \$125,000 face value cumulative participating bonds to be sold at not less than par.

NEW CATALOGUES.

Sprague Electric Works have issued a number of new bulletins of interest. No. 333 is a folder attractively listing Sprague electric fans for direct current. No. 48706 is devoted to a.c. motors and controllers, 2 and 3-phase, for printing press drive, with special reference to flat-bed and small rotary presses, folders and other machines requiring motors of from $\frac{1}{4}$ to 15 h.p. No. 48907 tells of Sprague 500 lb. Electric Hoists, particularly as regards safe and economic operation. No. 49600 illustrates and describes flexible steel armored conductors, flexible steel conduit, stamped steel boxes, fittings and tools.

The Western Electric Company has issued a new catalog of Inter-phones and accessories. The various systems available for intercommunication are fully explained with diagrams showing the service given by each. New systems recently developed include a new annunciator system arranged for from ten to seventy stations or more, and a new apartment house system to provide for inexpensive and flexible installations. The new catalog gives all the information needed by the dealer, or contractor who would select, install and operate an Inter-phone system designed to meet practically any known requirement for intercommunicating telephone service.

A new and unusually complete catalogue of Telephone Apparatus and Supplies is being distributed by the Western Electric Company. Following a section devoted to miniature reproduction of sales and service helps, are listings of telephones, switchboards, power plants, cable, line construction tools, line construction materials and miscellaneous telephone apparatus. The telephone section is in reality a telephone text-book, in that it enables the buyer of central office and subscriber station ap-

paratus to select exactly what he needs. This is made possible by unusually complete descriptions, circuit diagrams and directions for use. The Inter-phone section of the catalogue has been similarly assembled. Another feature is the uniform basic discount that applies to the list prices shown in the catalogue.

SAN FRANCISCO ELECTRICAL LEAGUE BASEBALL.

Due to the inconvenience of the wind and dust the league has decided to change their official grounds from the Ocean Shore to Balboa Park, at Ocean and San Jose avenues. This park, although a little further out, offers many advantages over the other grounds. Two diamonds will be used so that both games will be played at the same time, doing away with the disadvantage of a double-header. The grounds are grass covered and there are plenty of comfortable benches for the spectators. Both of the league games were played at Balboa Park last Saturday, May 27th.

Electric Appliance and Ermsco.

The Appliance boys took the first chance at swatting the ball, but the first two men up were struck out and the next man was put out at first. The Ermsco boys came up and connected with the ball for six hits, one of which was a home run and one a three-bagger. Three men were scored by Ermsco in this inning. The Appliance boys failed to score until the 8th inning, when they succeeded in making three runs, while the Ermsco boys had brought eleven men over the rubber to this part of the game. Appliance failed to bring in any more runs in the first of the ninth so the game was called at this point with the score 11 to 3 in favor of the Ermsco. Both pitchers worked well and received good support. Only two men were walked during the entire game, one man to each pitcher. Both pitchers struck out eight men.

General Electric and Western Electric.

This was another of those swat fest games, and appeared to be more of a race than a game. Western brings in 7 runs in the first inning, and G. E. succeeded in bringing in four. In the second inning Western got 5 more and G. E. doubled their score by bringing in 4 more runs. In the third inning Western scored 4 more runs, while G. E. was unable to score. The fourth and fifth innings neither side scored. In the sixth inning G. E. scored 2 more and Western was able to run 7 men around the bags. G. E. tried hard to tie the score in the first of the seventh inning, but were only able to land 2 runs. The game was called with a score of 23 to 12 in favor of Western Electric.

Standing of the Teams.

	Won.	Lost.	Pct.
Pacific States Electric Co.....	5	0	1000
Western Electric Co.....	4	1	800
Ermsco	2	4	333
Electric Appliance Co.....	1	4	200
General Electric Co.....	1	4	200

TRADE NOTES.

The Westinghouse Lamp Company announces the removal of its executive offices to the City Investing Building, 165 Broadway, New York, on June 1, 1916.

The Ward Leonard Electric Company, manufacturers of electric controlling devices, has moved into its new building at Mount Vernon, N. Y. The increased demand for floor space and labor operators is the reason for changing. The Ward Leonard Electric Company started manufacturing electric controlling devices in Bridgeport, Conn., in 1892. After two years in Bridgeport, and three years in Hoboken, N. J., they moved to Bronxville, N. Y., and have been manufacturing in Bronxville since 1897, or for the past 19 years. Mount Vernon is nearer New York than Bronxville—as a matter of fact, the new Ward Leonard Factory is 150 feet from the New York City limits.

FLOOD LIGHTING OF "JULIUS CAESAR."

BY E. L. NIGHTINGALE.

An audience of 40,000 people was given a glimpse of Old Rome, its populace, forum, arena, Capitol Hill, ravines, canyons and battlefields, on the evening of May 19, 1916, when 5000 actors presented Shakespeare's "Julius Caesar" in a 400 acre area unhampered by a stage or its confines, as it has never been presented before.

The buildings and clearings faithfully portrayed the Rome described by Shakespeare, but it was the General Electric flood lighting projectors that made the great spectacle possible at night. Flood lighting projectors were concealed in a unique and ingenious manner on the hill-sides to the right and left of the audience—in such a manner that the source of light was invisible. The light rays coming from two direc-

keeping the food warm from the time it left the kitchen until it arrived at its destination.

Mr. Chadron, general manager of the hospital, gave the problem careful study and finally designed and had built seven portable wagons. These wagons accommodate 26 trays and are arranged with sliding doors that make them practically air tight. A Western Electric navy type air heater is mounted on the bottom of the wagon with a cord and plug attachment capable of being connected ten feet away from the wagon. An hour before each meal the various heaters are connected to a source of electric current so that at meal time the interiors of the wagon are satisfactorily heated. After the wagons are loaded with the trays of food, the heaters are disconnected and the whole contrivance is placed on the elevator and raised to its destination where the heater is



Flood Lighting of "Julius Caesar."

tions on the stage formed a V, which gave the appearance of daylight on the buildings, stages and actors, but did not compel the actors to face a spot-light at any time.

Daylight effects at night were obtained by the addition of any coloring scheme required to portray the time of day, enhance the lurid glare of tragedy or the green light of intrigue, etc., by using color screens. No drop curtains were available, the stage being darkened by contrast, by throwing the flooded light on the audience—which concealed the changes being made.

Flashes of light on the six stages at various times were also made as a cue to the actors; this was very effective during mob scenes as instantaneous activity and enthusiasm were obtained. The true colors of the costumes were brought out vividly by the flood light. Five acres of ground were covered in a spectacular manner with six million candle power, the light being projected a distance of from 100 to 1000 ft. with excellent results.

In the last act a tremendous climax was reached when the armies of Cassius and Anthony met on the Philippian Plains. Their figures were sharply silhouetted by the light being placed back of the battlefield. The effect was weird and picturesque in the extreme.

The success of the production was due to the cooperation of all the prominent artists in the theatrical world, backed by the Hollywood Carnival Association and supported by other civic interests. The Pacific Light & Power Corporation at much expense provided an extension to their service and their representative, R. E. Smith, illuminating engineer, worked out the details and lighting effects in a practical and creditable manner.

HOSPITAL FINDS NOVEL USE FOR ELECTRIC AIR HEATER.

The St. Marks Hospital of Salt Lake City, Utah, has a set of four dumb waiters running from the basement to the first, second and third floors carrying food from the kitchen to the various wards. Great difficulty was encountered in

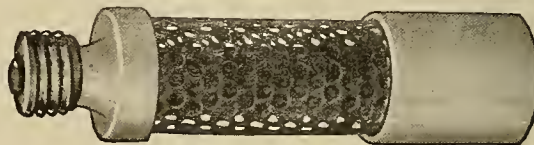
again connected to a source of current supply and remains so until the last tray is removed.

The new system is in constant operation and it is found to work perfectly—the food is served to the patients quite as warm and palatable as when it left the kitchen range. The installation has been the object of favorable comment in hospital circles.

THE ADAPTOR RESISTANCE.

The "Adaptor" resistance is a new form of convenience resistance unit made by the Ward Leonard Electric Company of Mount Vernon, New York.

This resistance consists of a Ward Leonard enameled resistance unit with an Edison base screw plug at one end and an Edison socket at the other end. This unit provides a convenient means of interposing resistance in a circuit. It can be furnished in practically any capacity and size required. It is used quite extensively to enable the universal



The Adaptor Resistance.

type motors to be used on either a.c. or d.c. on any constant given speed. It is also used in connection with low voltage apparatus when run on high voltages.

The resistance unit consists of a porcelain tube having a low temperature co-efficient wire wound upon it, the joint between the resistance wire and the terminal lead is made while the parts are bright and clean, under high pressure. The entire resistance winding, as well as this joint, is embedded in a coating of vitreous enamel, which thoroughly protects it from electrical, chemical and mechanical disintegration.



NEWS NOTES



INCORPORATIONS.

GRANGEVILLE, IDAHO.—Articles of incorporation have been filed of the Winona-Cottonwood Telephone Company Limited, the capital being \$1500. The place of business is Green Creek. The directors are Adolph Hinkleman, S. W. Hamill, Joseph E. Eller and J. J. Trautman of Green Creek and C. L. Morris of Winona.

ILLUMINATION.

LOS ANGELES, CAL.—The board of supervisors has made an order authorizing the furnishing of lamps for the present needs of the Bell Lighting District.

PASADENA, CAL.—The only bid received for the Green street lighting system was submitted by the Keystone Iron Works and the contract was awarded to that firm for \$1078.

LOS ANGELES, CAL.—Instructions have been issued to the board of public works by the council to advertise for bids for contract to light the streets for six months, beginning July 1.

CHLORIDE, ARIZ.—Robert Roe has been granted a franchise for the construction and operation of a plant for the generation of electricity for lighting, heating and power purposes in the town of Chloride.

LOS BANOS, CAL.—B. S. Pedersen was here recently to consult W. H. Worswick, Jr., and others regarding the installation of a gas plant. It is estimated a plant of sufficient size to meet the demands of Los Banos can be erected, fully equipped for \$20,000.

SANTA BARBARA, CAL.—Concrete ornamental lighting posts may be erected along Carrillo street from State to Castillo. Property owners express belief that arrangements might be made for immediate installation, and even for extending the system almost the entire length of the street.

TULARE, CAL.—The Tulare County Users' Association has been organized to protect and advance the interests of its members using electricity. Headquarters for the association are in Tulare, and the following officers have been elected: G. W. Jones, president; A. C. Rosenthal, secretary; C. W. Zartman, treasurer.

PHOENIX, ARIZ.—The city commission has decided to request the Department of the Interior to hold up the matter of approving the new power contract with the Pacific Gas & Electric Company until the people of Phoenix can vote on the bonds for a municipal electric light and gas plant. It has been proposed that an election be ordered to vote on bonds for this purpose in the sum of \$600,000.

TRANSMISSION.

OROVILLE, CAL.—J. M. Howell, chief engineer of the Great Western Power Company, states that surveys for the purpose of locating a site for a new power plant on the Feather River between Intake and Belden are being made.

SAN FRANCISCO, CAL.—City Engineer O'Shaughnessy has returned from Hetch-Hetchy Valley, after picking a location for a temporary power plant, which is to be built at an estimated cost of \$100,000 for supplying current for the construction of the dam. This power plant will be 12 miles from the big dam.

OCEANSIDE, CAL.—H. H. Jones, manager of the San Diego Electric Company, and H. M. Byllesby of the Byllesby Company, were here recently in connection with the proposed purchase of the local electric plant. A favorable decision is expected in a few days. It is stated that extension of the line from San Diego to Oceanside by August 1st is a strong probability.

NORTH YAKIMA, WASH.—The U. S. Reclamation Service, Denver, Colo., is taking bids until 2 p. m. June 5th for furnishing and erecting equipment for the Grandview irrigation project near North Yakima, Wash. The bids cover: Generator, transformers, switchboard equipment, hydraulic turbine, steel pipes, pumps, head gates, etc. Particulars from U. S. Reclamation Service at North Yakima, Wash.

TELEPHONE AND TELEGRAPH.

OROVILLE, WASH.—Mrs. Luella R. Anderson has sold the local telephone line to the Pacific Telephone & Telegraph Company.

KELLOGG, IDAHO.—The Interstate Utilities Company is planning to rebuild its entire distributing plant in Wardner and Kellogg.

VALLEJO, CAL.—The Pacific Telephone & Telegraph Company has applied for a franchise in this city. Sealed bids will be received for said franchise up to June 20th.

NORTH YAKIMA, WASH.—The Yakima Valley Telephone Company has filed with the county commissioners an application for a right of way for 50 years over county roads, for extensions of its lines south of Mabton.

SAN BERNARDINO, CAL.—The Union Home Telephone & Telegraph Company has offered its telephone plant to the city of San Bernardino for the sum of \$10, providing the city will vote to issue bonds amounting to at least \$400,000.

CHULA VISTA, CAL.—Work on the installation of a new Bell telephone exchange in Chula Vista, involving an expenditure of about \$25,000, will begin at once, it has been announced. Some of the field work is already under way. The new exchange will open with about 400 subscribers.

SANTA BARBARA, CAL.—Extensive rebuilding of all its lines over the county is planned for this summer by the Pacific Telephone & Telegraph Company, according to General Foreman Tucker, who has charge of construction work. It is stated that all lines between here and Monterey will be rebuilt, present poles being replaced with larger ones.

PLACERVILLE, CAL.—Local forest officials are planning the immediate construction of a telephone line in Georgetown district of the El Dorado National Forest, 9 miles in length, extending from Onion valley to Hartless ranger station. Another line approximately 5 miles in length is to be constructed to connect this line directly with Bald Mountain lookout station. J. M. Hughes and M. D. Morris will have charge of the work.

FRESNO, CAL.—Authorization for the expenditure of approximately \$36,000 to enlarge the service to take care of the new districts, to place wires underground and to make general improvements in towns near Fresno has been made by the general office of the Pacific Telephone & Telegraph Company, and it is thought the work will be finished within the next eight months. Long distance loops will be installed from Dos Palos to Mendota, Fresno to Jamison and from Fresno to Kerman. This work will cost \$4390, and will be completed within five months.

TRANSPORTATION.

PORTERVILLE, CAL.—Work has started on a survey of a system of interurban electric lines, subsidiary to the S. P. Railroad, to be built through the mining section and into orchard areas where new groves are coming into bearing. Engineers who took the field are J. Roy Clark, L. H. Conway, W. T. Davey, and K. F. Biehler, all of whom were formerly with the engineering department of the Pacific Electric Railroads.

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SAN FRANCISCO, JUNE 10, 1916

PER COPY, 25 CENTS

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EFFICIENCY IN INDUSTRY.

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REPORT OF N. E. L. A. RANGE COMMITTEE.

FEASIBILITY OF ELECTROCHEMISTRY AT THE DALLES

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INDUSTRIAL PREPAREDNESS.

BY GEO. W. DICKIE.

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MERCED FALLS LOW HEAD HYDROELECTRIC PLANT

BY A. S. KALENBORN.

The San Joaquin Light & Power Corporation has recently completed a low head hydroelectric plant at Merced Falls. The unusual feature of the plant as regards Pacific Coast practice is the low head and the use of an open flume type turbine.

In the utilization of the power of a large, sluggish stream, such as one finds east of the Rocky Moun-

ulator, and the possibility of maintaining service on the local lines by it in case of main line interruptions.

Merced Falls, so called from a 12 ft. drop in the bed of the Merced River at a point where it emerges from the rugged mountains into the foothills, is in Merced county, about twenty miles northeast of the city of Merced, quite near the boundary line between



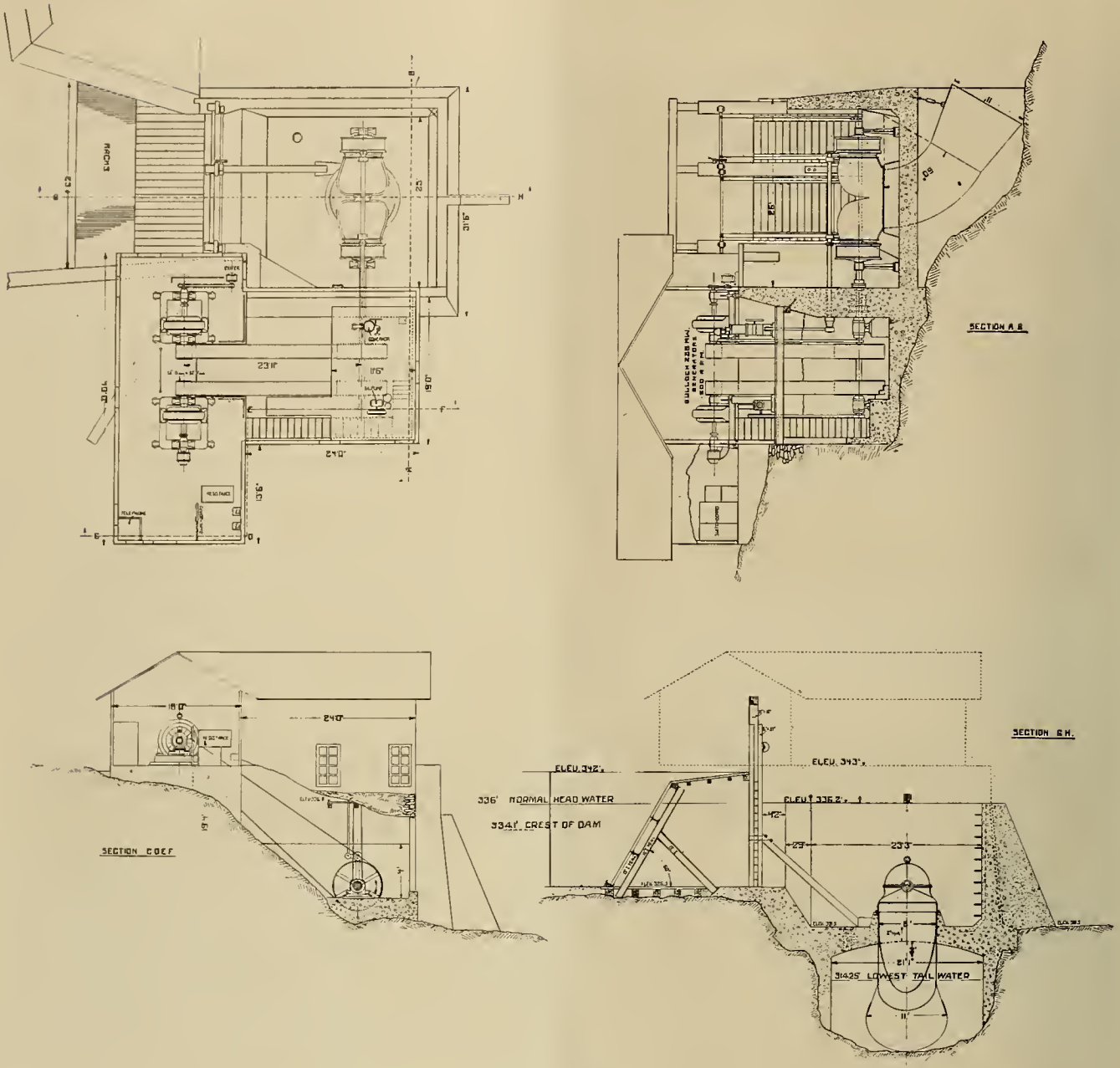
Merced Falls Dam, With Flood Passing Over It.

tains, the formula for power $P = QH$ should be written $P = Qh$, whereas, out on this western edge of the continent, where small, torrential streams with heads up to 2000 ft. are put to work, we should more properly write the formula $P = qH$. The foregoing will explain why the writer has prepared this description.

The San Joaquin Light & Power Corporation operates steam and hydroelectric plants, supplying power to a network of transmission and distribution lines covering almost the entire San Joaquin Valley. Five hydroelectric plants feed into the system, the most northerly one being that at Merced Falls. Because of its location at the end of a long 30,000 volt line, feeding the Merced and Madera districts, even a small plant, like the one about to be described, becomes important when one considers its value as a voltage reg-

ulator, and the possibility of maintaining service on the local lines by it in case of main line interruptions. Merced Falls, so called from a 12 ft. drop in the bed of the Merced River at a point where it emerges from the rugged mountains into the foothills, is in Merced county, about twenty miles northeast of the city of Merced, quite near the boundary line between Merced and Mariposa counties. The river rises in the Sierras, near Mount Lyell, in the Yosemite National Park, flows southwest about 100 miles, and later empties into the San Joaquin River north of the city of Merced. It is the same water which, tumbling down the perpendicular walls of the Yosemite Valley in the many beautiful waterfalls, delights the eye of the tourist, that is put to the commonplace work of generating electricity in the plant at Merced Falls.

Power sites within the broad valley of the San Joaquin are scarce, so we find that as early as 1854 advantage was taken of this mill site by Wm. Nelson and Son, who built a grist mill there. A low timber-crib dam was built to create a storage pond and to increase the head, and a primitive water wheel was used to turn the millstones that ground the wheat.



Power Plant Details.

In 1868 Wm. Nelson and Son, with a few small stockholders, built a woolen mill adjoining the flour mill. On the 4th day of April, 1872, the woolen mill and flour mill both were destroyed by fire. In the same year the woolen mill was rebuilt. The old timber dam was also replaced by another of the same type. On September 23, 1893, the woolen mill was again destroyed by fire, but this time it was not rebuilt. The country about Merced Falls was at this time largely devoted to sheep raising.

A year later, 1894, the power was applied to the generation of electricity, when the Mt. Gaines Mining Company installed a vertical turbine to drive a 135 kw. belted Stanley generator. Power was transmitted a distance of fourteen miles to the east at 10,000 volts, to the Mt. Gaines mine.

In 1896 the Merced Falls Gas & Electric Company installed two 75 kw. Brush alternators, and two vertical turbines in a pit adjoining the Mt. Gaines wheel, and transmitted the power to Merced at 10,000

volts. These plants operated independently until 1900, when the entire installation was taken over by the Merced Falls Gas & Electric Company.

In 1901 the old wooden dam was replaced by the present permanent concrete dam, which is more than 500 ft. long and about twenty feet high.

In 1903 the Brush machines were replaced by a Bullock 225 kw. generator, and in 1910 a new transmission line was built, of No. 2 copper on forty foot poles, insulated for 30,000 volts.

In January, 1911, at the time of the "big flood," the water flowing around the end of the dam undermined the power house foundations, which had not been carried down to bedrock, and wrecked the plant. The electrical machinery was salvaged, but the power house site has stood idle since that time, although the lake above the dam has been used as a mill pond by the Yosemite Lumber Company, which operates a large modern sawmill and box factory there.



Condition Before Starting Work: (1) Old Foundations of Former Power House; (2) Excavation and Remnants of Old Tailrace; (3) Concrete Conveying Runway on Dam Crest; (4) Tailrace Before Excavating Island and Slate Point.

The pond has an area of approximately 40 acres, and there is a possibility of varying the level through a daily range of three feet, so that at low water stages this 120 acre feet of pondage is available for operation over the "peak." There is no storage in the water shed above Merced Falls, the natural flow of the river varying between a maximum of 40,000 c.f.s. and a few hundred c.f.s. at low stages.

In the summer of 1915, it was decided to rebuild the plant on a permanent basis, utilizing concrete on bedrock, and work on the plant was accordingly started the end of September, at the time of low water.

Referring to the drawing it will be noted that at



Progress of Construction. (1) Lowering 60 Degree Draft Tube Elbow Into Position; (2) View From Dam, Showing Reinforcing Steel of Turbine Chamber and Draft Chest; (3) View From North Bank; (4) Moving Draft Chest and Runners Into Turbine Chamber.

the north end of the dam, a 20 ft. section next the shore end has been omitted, the opening thus created being closed by two wooden vertical lift gates. A grating of $\frac{1}{4}$ in. by $1\frac{3}{4}$ in. by 16 ft. iron bars, spaced $1\frac{1}{2}$ in. on centers, placed in front of the gates, prevents any large particles of wood or bark from entering the wheel chamber.

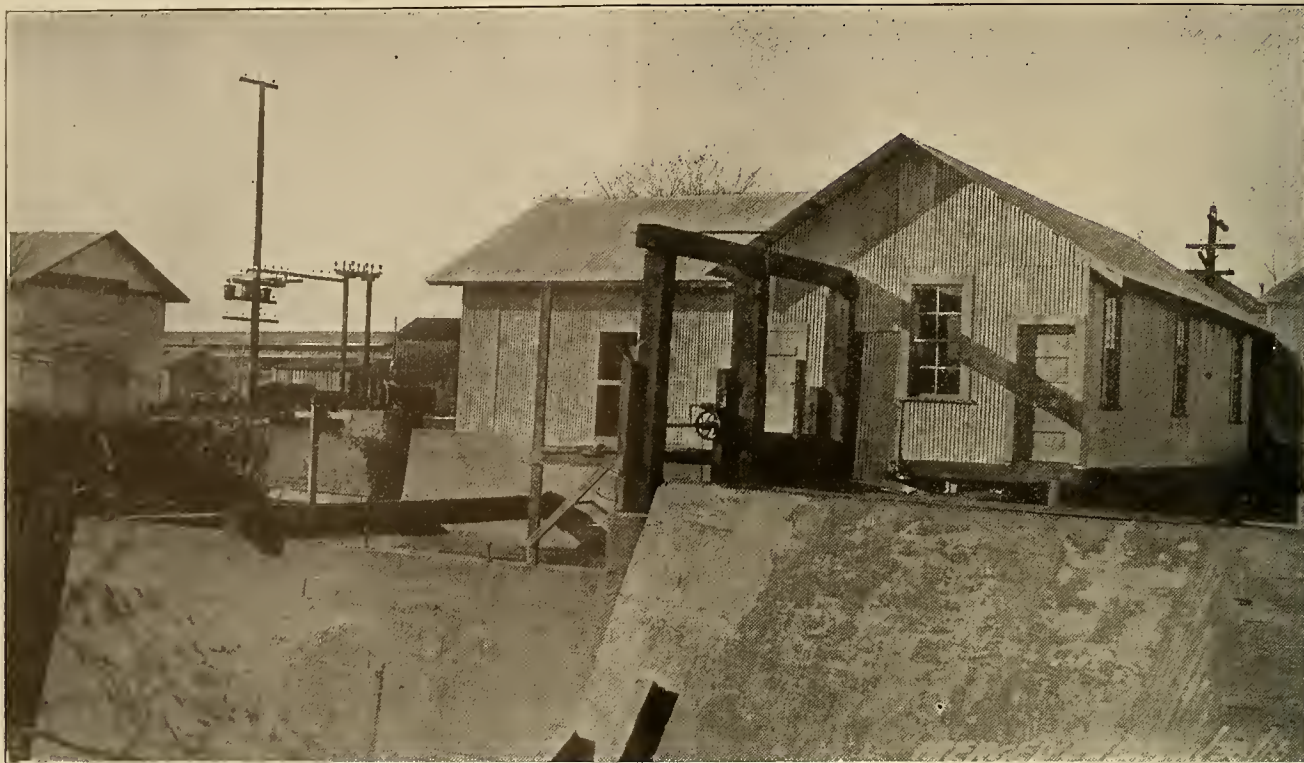
The turbine chamber is a reinforced concrete box with open top and side, roughly a 25 ft. cube. The chamber or flume is so placed that the wooden gates close the open side. The arched floor spans a raceway 21 ft. wide, and the water is discharged from the wheel

into this raceway through a circular 8 ft. diameter curved draft tube flared to 11 ft. at the outlet.

The wheel or turbine is simply "drowned" or submerged in this chamber, the governor and main drive shaft, both horizontal, passing through stuffing boxes in the northerly wall. Inspection or repair of the turbine necessitates draining the chamber. The installation is simple, and is evident from the drawing.

volt transformers in the substation, about 150 ft. distant from the power plant. The 11,000 volt power is either absorbed by the local distributing lines to the mines, gold dredgers and rock crushers in the district, or is stepped up by the 11,000/30,000 volt substation transformers for utilization in the Merced district.

The plant has been operating satisfactorily since power was first put on the line, the generators divid-



View of Power House From Dam.

The turbine is of the twin horizontal, central discharge type, with a pair of 36 in. diameter, type "R" runners, made by S. Morgan Smith Company, designed for an output of 750 h.p., at 20 ft. head, 186 r.p.m. The shaft is 39 ft. 9 in. long, 7 in. to $8\frac{3}{4}$ in. in diameter, coupled just inside the flume wall for convenience of installation and overhauling, and runs on three lignum vitae bearings in the wheel casing, and in two large babbitted ring-oiling bearings in the pulley pit. One of these bearings is an adjustable thrust bearing to hold the runners in axial position. There are two driving pulleys 82 in. in diameter with 25 in. face, from which inclined leather belts drive the two generators. The efficiency of the wheel between 0.8 and 0.92 gate opening exceeds 82.5 per cent, with a maximum at 0.86 of 83.5 per cent.

The output of the wheel is controlled by wicket gates, 12 radially placed wickets or vanes, closed and opened by the governor, (working similarly to a hot air register), arranged in an annular ring about each runner. The runners and draft chest are plainly shown in the drawing. A Woodward, 10,000 ft., pound oil pressure, vertical type, governor is installed just above the main driving pulleys.

The electrical end presents no novel features, two Bullock, 225 kw., 2300 volt, 3 phase, 2300 volt, 600 r.p.m. revolving field generators being belted to the water wheel, and delivering their output to three General Electric, 150 kw., single phase, 2300/11000

ing the load equally without any special arrangements. The governor holds the speed so closely that synchronizing is effected very easily. The plant was built by the San Joaquin Light & Power Corporation's own engineering department, under the supervision of the writer.

Water power for paper making promises to be an important industry in the West, where most of the woods used in paper pulp are obtainable. The Forest Service laboratories at Wausau and Madison, Wis., have recently found eleven new woods that give promise of being suitable for the production of news print paper, while a number of others will produce manila paper and boxboards. Most of these woods are confined to the West, while the groundwood industry now obtains the bulk of its raw material from the East. It is thought that pulp-making plants must eventually move to points where they can obtain a plentiful supply of wood and an abundance of cheap waterpower, two prime requisites in the business. Since the National Forests contain immense quantities of the suitable woods and abundant opportunities for power development, they will undoubtedly play an important part, it is said, in the future of the wood pulp industry. White and red fir are the most promising species in the national forests in California, although lodge-pole and western yellow pine and Douglas fir may sometimes be used.

EFFICIENCY IN INDUSTRY.

BY O. B. COLDWELL.

(This suggestive paper was read before the Oregon State Conference of Social Agencies, held at Reed College, Portland, May 12, 1916. The author is general superintendent of the Portland Railway, Light & Power Company.—The Editor.)

Organized industry, according to the common conception of the term, brings to mind a plan for the accomplishment of work along preconceived lines which have efficiency of production as their object. In any branch of industry it is necessary to have a definite working organization or plan of operation which requires the employment of labor and the use of materials. Whether an industrial plant is operated efficiently or inefficiently depends to a large extent upon the thoroughness and suitability of the planning scheme.

The line between efficiency and inefficiency is not sharply drawn and the terms are relative only. The engineering definition of efficiency is the ratio of output to input in connection with any piece of apparatus or operation measured in like units. It is difficult to apply this definition to industrial operations because the input represents in most cases the employment of a great number of different kinds of labor and the use of many different kinds of materials. In many cases the output is also of varied character and so we do not always find a suitable unit for the comparison of input and output. We might, however, determine the value of the output in dollars and divide it by the value of the labor and material employed, in which case the amount over 100 per cent would represent the degree of profitableness of the industry under investigation.

The greatest increases in industrial efficiency have been attained by the application of mechanical power to supplement or supplant human or animal power. The mechanical advantage brought about by the use of machinery has expanded the usefulness of the human unit many fold.

"Power is the basis of our material progress," says Franklin K. Lane, Secretary of the Interior, in a recent article on "The Industrial Future of the Nation." The productive abilities of our 100,000,000 people are increased by the use of probably 125,000,000 h.p. of mechanical energy, not including animal power furnished by 130,000,000 horses and mules.

"Most of the mechanical energy is used in the form of electrical current. When applied to industrial uses, one electrical horsepower does the work of ten men without tiring. That is, one electrical horsepower does as much work as thirty men working in eight-hour shifts.

"Conservation of human labor goes hand in hand with utilization of mechanical energy.

"We now use about 6,000,000 h.p. of water doing the work equivalent of 180,000,000 men, but we are wasting because we are not utilizing it ten times as much."

The water power illustration serves well to show the possibilities of rendering our industries more efficient by the application of mechanical power derived from water.

Now, what of the inefficiency of the human unit? Before machines can be applied to the work they are accomplishing along all lines of industry, it is neces-

sary for someone to devise and plan the machines themselves and to do so means that the whole scheme of operation must be studied out and understood and the machines made to fit the conditions.

Now, can we not draw a parallel in the case of our human machine? If it is to properly perform the work it has to do, its work should be likewise planned. Of recent years we have heard much about so-called Scientific Management, and what is scientific management? Some seem to imagine it is a something that may be prepared and applied as by means of a brush, or that someone can be found who possesses the idea and can bring it in and leave it. Not at all. Scientific management involves the intelligent understanding of the work in hand, the proper planning of the various operations in a logical order and the coordination of all elements of the organization in the performance of the task.

There must be in an organization an acceptance of this idea if efficient methods are to prevail. The individual must subordinate himself to a general scheme. Not that it is necessary to do away with all initiative of the individual, but it must manifest itself in a different way.

Just as the characteristic curves of an electric motor may be produced by one able to analyze its workings, so may the characteristic curves of human endeavor be secured.

The study of human efficiency has been taken up in a systematic manner. Time studies and motion studies, both of machines and of human operators, are made with the idea in mind of obtaining a definite and exact knowledge of their workings and of eliminating wasted motions and time. This is an educational work.

When the characteristic curves of two men performing an identical task are compared, it will be found that in order to produce the same unit of product, one uses 30 per cent more motions and takes a correspondingly longer time. It is essential if the slower one is speeded up to the standard of the faster that his work be planned differently and he must learn a new way. If this is accomplished, it will be because he is willing to accept a plan of work somewhat different from that which he has previously followed. In other words, increased efficiency must be the result of willing cooperation. The personal make-up, therefore, is of prime importance in determining the ability to secure greater efficiency.

As the application of labor-saving devices and machines increases and efficient methods of doing work are initiated, the problem in industrial management becomes more and more the problem of securing high-grade employes. The work formerly done by manual labor is to a large extent being done by machinery under expert supervision.

However, in the working out of industrial organizations, it has been found that the efficiency grade of employes varies greatly with the kind of labor or work upon which they are engaged. The centralization of operations has also to a large extent brought about specialization in employment, and while an employe may be grossly inefficient in one kind of specialized work, he may prove to be an excellent workman when attempting to perform some task for

which he is better fitted by training, by natural inclination or adeptness. In the Century Magazine Mr. Will Irwin states the following:

"The engineers practicing scientific management have lately taken hold of the printing business, and are in process of reducing its operations to law. They found in one of the clerical positions handling balances a man who had no bent for figures. He was, however, a 'reading man'; he had a passionate love for books. When they discovered this, they put him into the proof-room, gave him special night instruction, and made him a master of that craft. The present manager of another shop was a shipping clerk. Only fairly efficient in a position requiring merely accuracy and a little deftness, he seemed to have a mind for large complexities and a 'way' with men. He was tried in the management, and he went up steadily. The present superintendent of a large cotton mill entered its employ less than four years ago also as a shipping clerk. He had had no previous experience in the industry."

Many large industrial organizations maintain employment bureaus in order to insure a high standard in their employes and a great deal of study is given to the subject of the assignment of the employes to the line of work for which they show themselves to be best fitted.

Another subject to which much attention has been given lately is that of the development and training of employes for better positions. Industrial managements find that by increasing the individual efficiency of their employes through educational training and encouragement that the production efficiency of their plant is increased.

The habits and characteristics of the employes are studied in great detail, in fact, more in detail than the employes study themselves, so that they may be employed at work where their useful production, or effectiveness, or efficiency may be a maximum. Self-analysis is encouraged for the same reason. Men are tried at various kinds of work in order that their "characteristic curves" may be obtained. Training schools are established, lectures are given and educational meetings held, all with the idea of developing the employe, of giving him greater knowledge of the business in which he is engaged and of the requirements in order that he can be of greater service and be more efficient.

In the foregoing an attempt has been made to point out that the very essence of efficiency in industrial management consists of the application of carefully devised plans to the performance of every operation by itself, of the combination of the individual operations into a well-balanced whole, and further, that there is embraced a detailed knowledge of all of the parts of the business, including study of the human as well as of the inanimate elements.

There are also to be considered in connection with efficiency in industry certain elements which are more or less external to the direct operations themselves and which do not always come under the direct control of the management.

Industry requires capital. Large industries, where the principles of efficiency can be more thoroughly applied, require that investments of capital

must be made by those who have it to invest and their willingness to invest is dependent upon the probability of the investment becoming a profitable one. Especially is this true of the large public utility industries such as railroads, street railways, gas, water, telephone and light and power systems. These industries are continually striving to apply the principles of efficiency to their internal organizations and operations with the object of rendering better public service and of earning a return upon the capital already invested. In order to encourage such industries and to obtain additional capital to carry out plans for extension, it is necessary that they be allowed a reasonable profit on the present investment over and above the expenses incident to the operation of the plants.

A new community such as this which is burdened with a lot of new and untried laws seeking to hamper and restrict business, will not find it an easy task to induce additional capital to come in and invest. To apply regulation in such a degree as to destroy the confidence of investors is a great mistake and it should be the aim of such organizations as this to work in the interest of such laws as will tend to establish confidence on the part of the investing public in order that we may have in this community the influx of capital which is so much needed to promote additional industries.

ELECTRICAL INSTALLATION ON INSPECTED VESSELS.

The Board of Supervising Inspectors of the United States Steamboat-Inspection Service has adopted specifications for electrical installation contracted for after June 30, 1916, on all vessels coming under the jurisdiction of the service which use electricity for lighting. The specifications have been approved by the Secretary of Commerce. The rule reads:

On all vessels contracted for after June 30, 1916, using electricity for lighting, the installation shall be in keeping with the best modern practices. Wires shall be run in approved iron conduits, armored casing, or molding. Iron conduit or armored casing shall be required in bunkers, cargo spaces, storerooms, etc., and in all places where the leads are liable to mechanical injury. Joints in wiring shall be avoided as far as possible in the above-named spaces. Where wires are led through beams, frames, or nonwater-tight bulkheads, they shall be carried either in iron conduits, armored casing, or protected by hard rubber, or other equivalent bushings. Where wires are carried through watertight decks or bulkheads, they shall be provided with a suitable stuffing box at deck or bulkheads. Where such points are liable to mechanical injury, they shall be protected by suitable boxes or cages.

In locating the wiring system as a whole, care should be taken to provide accessibility for examination and repair. Special care shall be taken to avoid any arrangement which might permit the lodgment of standing water.

All taps, joints, and splices shall be fitted with water-tight junction boxes.

Joints shall be so spliced or the parts so joined as to be both mechanically and electrically secure without solder. They shall then be soldered and properly insulated and further protected by waterproof tape.

REPORT N. E. L. A. ELECTRIC RANGE COMMITTEE.**Merchandising Problems and Co-operation With Manufacturers.**

(Continued.)

There are two classes of manufacturers to whom the industry may look for the most practical developments in the electric range.

First, manufacturers who have, in the past, been successful in the making and merchandising of electric household appliances for which a large demand has been created during the past few years.

Second, manufacturers of gas ranges who have already developed the most desirable and advanced types and designs in ranges, and who could readily equip for electric purposes the best numbers of gas ranges, for which there is a popular demand. Such adaptation would, as a matter of course, tend to keep down the usual high development expense pertaining to the designing and placing upon the market of any new line of products.

During the course of our correspondence with the different manufacturers there developed some discussion as to the advisability of the manufacturers forming an Electric Range Manufacturers' Association to consist of representatives of the leading electric range manufacturers of the country. The suggestion in this matter originally emanated from one of the manufacturers, and the sub-committee handling the intercourse with manufacturers was naturally much interested in the suggestion of forming such an association.

The sub-committee fully realizes that there are some matters in connection with the standardization, development, advertising and handling of the electric range concerning which it would seem as if it would be absolutely necessary for the manufacturers to consult with each other. It is recognized that the central stations as well as the manufacturers are intensely interested in the future of the electric range, and the sub-committee is of the opinion that co-operation among the manufacturers, through an organization of a committee, for the discussion of electric range problems and the promotion of the sale and use of this appliance would undoubtedly be of great benefit to all concerned.

At the same time the sub-committee was reluctant to make any definite suggestions to the manufacturers themselves in the matter for fear that what was suggested might be misunderstood, or that the Association of Manufacturers, if formed, might not confine its work to such matters as would at all times be agreeable to the central stations.

The licensee arrangement under the Marsh patent, will, we are informed, necessarily include all manufacturers of electric appliances, and this arrangement will no doubt point toward an association of manufacturers. The sub-committee is of the opinion that such an association is likely to be of inestimable value in connection with the handling of suggestions from central stations or from a committee representing central stations. In addition, such an association formed, following the licensee arrangement referred to, would no doubt be of the greatest value to the manufacturers themselves in the development and merchandising of the electric range.

Experience of Central Stations.

Compilation of data in answer to questions addressed to forty-six operating companies shows the following facts:

Types of ranges sold up to the present time have been the products of five manufacturers, all but one of whom have been making various electric appliances for some years past. There were 4659 ranges reported sold, the majority of those apparently giving good satisfaction both as to operation and number of burners and sizes of ovens. The principal mechanical complaints were burning out of elements, slowness of operation and fragile construction. There seems to be a variance in opinion regarding the relative merits of the open coil and enclosed burners, the former apparently being the more popular. The type of electric range most desired seems to follow the lines of the popular gas ranges. There should be four 3-heat burners on the top (one 1500 watt; two 1000 watt; and one 750 watt). The side and upper ovens are by far the most popular. Ovens should be at least 12 by 15 by 18 in. and should contain a broiling element and a baking element. A warming oven above or below the baking and broiling oven is a desirable adjunct. The doors on side ovens should open down.

Installation.—After an electric range is sold it is important that the installation should be of a proper character and at a reasonable cost. It is apparent that the variation in cost of installation—that is, from the meter in, depends largely upon local requirements. In some localities the standard of construction required is much higher than in others—hence the variations in the cost of installation. About two-thirds of the companies do the necessary wiring from the meter to the range, and install the range itself. The remaining one-third do no wiring but deliver the set up ranges when sold by them. Apparently the companies putting out the greatest number of ranges are doing all wiring in connection with installations. Costs of installing electric ranges in consumers' kitchens vary from \$4 to \$30; the average being approximately \$12.50. All companies make installations of electric ranges at cost excepting eight who charge a profit of 10 per cent.

Merchandising.—There are many ways and methods of selling electric ranges to consumers, and these indicate a considerable variation of opinion as to what are the best means to be adopted. The answers to the questions seem to demonstrate that in order to create an interest in electric cooking and promote the use of electric ranges, the central stations had better handle the business, at least in the early stages, and make installations to consumers at cost, or as near to cost as it is possible to reach. Most companies sell electric ranges to their customers, one-half at cost and the other half at a small profit. Apparently very few dealers have become interested in the sale of electric ranges up to the present time. The majority of companies reporting state that dealers are not handling electric ranges and consequently there is little chance to co-operate. As the more progressive central stations find it necessary to make first installations of ranges at cost or with such small profit that, for a while at least, dealers will not be able to see much that is attractive in electric range installations.

The principal difficulties in selling electric ranges, indicated by companies reporting, are the following; their importance being in the order given:

- (a) First cost (including installation);
- (b) Anticipated high operating cost;
- (c) Lack of economical water heating facilities;
- (d) Slow operation;
- (e) Skepticism and lack of confidence;
- (f) Disposition of old equipment;
- (g) Satisfaction with present means of cooking.
- (h) Necessity for heating kitchen during winter months.

A large number of electric range installations are reported to be made upon deferred payment plans, the limit of payment varying from three to twelve months. The majority of companies endeavor to hold the limit of payments down to a six-month period, but fully one-half of the companies reporting seem willing to make sales on deferred payments extending beyond six months.

About one-third of the companies reporting, state that they sell electric ranges on deferred payments at the same prices as for cash. The remaining two-thirds report that they make additions to the cost price varying from 5 to 15 per cent, the average being 10 per cent advance when purchases are made on a deferred payment plan.

Excepting in three instances, all companies reporting state that they maintain display rooms in their offices.

With two or three exceptions all companies reporting state that they select the best of each manufacturer's products to suit their local conditions. The exceptions state that they order from one manufacturer only, so as to obtain quantity prices.

The average consumer apparently is not willing to pay more than \$30 to \$40 for an electric range but he can be educated to raise the price if the reasons given are satisfactory. The majority of companies report that the average consumer will pay a price varying from \$40 to \$50 to get the type of range desired. The average of a few of the companies reporting seems to be in the neighborhood of \$50.

The majority of companies reporting believe that, under present conditions, the lowest priced range which would at the same time be durable and efficient, should be from \$30 to \$35 and contain at least three burners with a side or upper oven. A number of companies fear the results of putting ranges upon the market which may be low priced at the expense of durability and efficiency, believing that ranges of this character will do more to hurt the electric cooking business than to help it.

Other fuels naturally compete with electricity for cooking purposes. Thirteen companies report no gas competition. Eight companies report operating gas properties alongside of their electric properties. The remaining companies report either natural or artificial gas at rates varying from 68 cents to \$1.60 per 1000 cu. ft. the heat units varying from 550 to 1000 B.t.u. Companies selling gas as well as electricity do not seem to be inclined to put the electric range in competition with the gas range. Most of the companies operating electric properties report the majority of their sales of electric ranges in territory not supplied with

gas service. However, one company whose electric range sales have reached large proportions, reports that about 31 per cent of their sales of electric ranges have been made in territory not served by gas, and 69 per cent in territory supplied with gas service.

The varieties of fuel outside of gas with which the electric range would have to compete, are numerous, comprising coal, wood of different qualities and varying expense, coal briquets, crude oil, kerosene, gasoline and distillate. In some of the mountain states coal is as low as \$3 per ton and wood as low as \$2 per load. The price of crude oil for stove purposes is approximately 3 cents per gallon; kerosene, approximately 16 cents per gallon; gasoline, approximately 18 cents per gallon and distillate approximately 8½ cents per gallon. The reports from various companies indicate that where gas is not supplied as fuel, the electric range competes with different kinds of fuels according to the geographical location. In some states coal is the principal competitor. In other states wood is almost the only competitor and in other states, principally in the south, oil is largely the only competitor because of its cheapness and because other fuels, (coal and wood) are relatively high priced.

In the territory where there is no gas competition, the principal reason the average consumer will not buy and use an electric range is that he is not familiar with the advantages of electric cooking. Some companies report that the very low cost of wood (mill refuse) for fuel, prevents the consideration of electric range installations. Several of the companies report the water heating difficulty as an obstacle and also the necessity of having heat in the kitchens several months of the year on account of climatic conditions. The financial conditions during the past two years are also given as a reason by two or three companies why more interest has not been created in this subject.

General Merchandising Information

With the idea of obtaining all the information possible bearing upon this subject as a result of the experience of the companies reporting, some leading questions were asked, and the replies received are mostly practical and entirely interesting.

The following quotations give the ideas of some of the companies on dealing with manufacturers in order to obtain an ideal electric range at the lowest possible price:

"The manufacturer should be willing to stand behind his product with a proper guarantee, and willing to defer some of the profits from the business until a future date, and not hope to make all on the first few ranges sold, but bring the price down as low as possible and let the central station have an opportunity to put out more ranges."

"Standardize requirements of the central stations so as to limit the types of ranges made by different manufacturers and thus reduce their overhead expenses. Also show manufacturers that increased output depends primarily upon lower priced ranges."

"Develop hot water attachment and durable elements."

"It seems as if a canvass of number contemplated to be used would allow greater number to be made and this would allow cut in price, or manufacturing company could sign tentative contract to sell at certain

reduced price if certain specified number were ordered by entire trade."

"Power companies to combine in order to secure quantity prices."

"Standardization of types should reduce production costs. Some method of collective bargaining between representatives of the manufacturers and central stations to establish standard designs for a predetermined period might work to the mutual advantage of all concerned."

"Standardize and cut out novelty idea."

"A maximum production to lower unit cost."

"Through increased output; central stations could club together and order a certain number in advance."

"Dispense with nickel and frills unless especially ordered."

"Standardize so as to cut down manufacturers' cost."



Shipment of 60 Electric Ranges Installed in Santa Ana District of Southern California Edison Co.

"Study the gas range closely and capitalize its experience."

"Let the electric manufacturers make the element and the stove manufacturers make the stove."

"Ship complete line of repair parts to the distributor."

"Manufacturers should be more particular in details and mechanical construction."

"Do not load the development cost on first shipments."

"Better insulation in oven on cheaper ranges."

"Standardize on design and equipment. Reduce number of types of ranges and talk quantity to the manufacturers."

The following quotations give the ideas of some of the representative companies as to methods of special value.

"Install one in each community on trial and use it as a demonstration."

"Personal solicitation and demonstration."

"Expert instructions and frequent visits for tests."

"Get an efficient range properly installed in a consumer's residence. That consumer, satisfied, will use the range and talk about it; which will be the best advertisement for same."

"Deferred-payment plan. General use of electric ranges among company employes. Testimonials of satisfied users of the ranges. Demonstrations on large scale, as well as follow-up work of all new installations by demonstrators. Domestic science equipment in the

schools. Continuous publicity work as to the advantages of electric cooking."

"Thirty days' free trial."

"Cooking schools and demonstrations. Salesmen to follow up prospects closely."

"Install range on trial; a good conscientious salesman will make it stick."

"Judicious advertising and personal letters."

"Sell range installed on small monthly payments, making allowance for old equipment."

"Personal solicitation by well informed, enthusiastic salesmen has done most for us. No one plan, however, can be relied on altogether. Any well directed method of educating the public will prove a good merchandising method."

"Personal solicitation. Don't wait for the customer to go to the demonstrations. Let the salesman make an appointment and bring the customer to the office and give a special demonstration and close the sale. After the installation is made, don't wait for the customer to send in a complaint. Anticipate the complaint. Call upon the customer regularly to inquire and give information and call the customer up on the telephone between personal visits. The satisfied customer immediately becomes a salesman without pay."

Expectation as to number of ranges to be sold in the West during 1916 total ten thousand.

(To be continued.)

FEASIBILITY OF ELECTROCHEMISTRY AT THE DALLES.

BY O. F. STAFFORD.

(Concluded.)

Phosphate Industry.

In the discussion of raw materials earlier in this report it was stated that eventually the major reserves of phosphate rock existing in the territory just east of the Oregon line must be called upon to supply the demands of agriculture for phosphate fertilizer.

Unfortunately the technology of the treatment of phosphate rock in a large way in the electric furnace or by other electrical methods is still in a pre-commercial stage to a degree which makes any attempt to subject it to a close analysis quite out of the question. The most that is known about this matter is that much research energy accompanied by very large outlays of money for the experimental work, is actively engaged upon the problem, with now and then a statement being thrown out indicative of satisfactory progress.

For example one of the principle interests engaged in this endeavor has asserted that it is possible to turn out phosphoric acid by use of the electric furnace at a cost somewhat less than the present cost of the same as produced in the form of super-phosphate by standard practice using phosphate rock and sulphuric acid. To be sure the power rate necessary for this is a very low one, being given as \$5 per horsepower-year. It has been announced, moreover, that this particular interest expects to develop the power existing at the outlet of Lake St. John, Canada, where it is said that upward of a million horsepower can be obtained at a cost not greater than the above named figure, and at this site establish a plant to handle

phosphate rock shipped by water from the southeast-ern states.

The details in the above paragraph are of interest, of course, simply as an indication of what is being striven for in this department of the phosphate industry. From it, however, it may also be seen that in spite of the long distance of this power site from the raw materials and from the final market, and in spite, too, of the fact that for five months in the year water transportation will be closed by ice, the project is under serious consideration. It consequently may not be hoping against hope that in time our western water powers may be used in connection with our phosphate deposits even though it is doubtful about ever securing any of this power at a rate as low as \$5 per horsepower-year.

The industrial situation however, into which such an enterprise would enter may be roughly outlined.

Present super-phosphate practice yields by the use of phosphate rock and sulphuric acid a material containing only 18 per cent phosphoric acid. The cost per pound of the phosphoric acid under Atlantic Coast factory conditions is given at 2 cents, assuming a price of \$4.50 per ton for high grade phosphate rock and \$4.75 per ton for sulphuric acid. In Montana, making use of local phosphate rock and the cheap sulphuric acid produced at a smelting center such as Anaconda, it is estimated that phosphoric acid in the form of super-phosphate would cost only 1.3 cents.

Since over 80 per cent of the above product would be useless as phosphate fertilizer its radius of distribution would be limited as compared with any product richer in active phosphoric acid. Now electric furnace methods, if successful at all, would turn out highly concentrated forms of phosphate material and, always provided that unit costs are not too far apart, these could enter competitively any region not near to conjoined sources of both phosphate rock and sulphuric acid such as exist in Tennessee and Montana.

It is the consensus of opinion among those who have given much study to the question that the logical product for an installation attempting to make phosphate fertilizer by aid of electrical power is ammonium phosphate. This substance would be ideal from every point of view—its suitability as a fertilizer, containing as it does both phosphorus and nitrogen, as well as representing forms of both so concentrated that it could go easily into the world market. Its manufacture would involve the use of one of the hoped-for electric furnace methods of making phosphoric acid and also one of the methods discussed above for obtaining ammonia from atmospheric nitrogen.

In Conclusion.

The survey of electrochemical industries undertaken in the interests of the possible utilization of the water power at The Dalles, Oregon, by electrochemical manufactures has revealed the following facts:

The electrochemical centers of the East have grown up as the result of peculiarly favorable conjunctions of power, materials, capital, labor and markets.

In the West the single resource which more advantageously presents itself than in the East is power,

while owing to the fact that most electrochemical products are "heavy," the matter of market, particularly, which is almost altogether in the East, becomes impossibly remote.

Power cost, moreover, in most of the industries, is a minor charge against the total expense of production and consequently can be increased to points far beyond those at which very large amounts of power are still to be had in the East before neutralizing the other advantages inherent in an eastern location.

Costs of materials, capital and labor are slightly greater in the West than in the East.

Utilization of western water power for electrochemical industries must therefore be limited at present to the manufacture of certain commodities for local consumption or for the Orient. The commodities which might so be made in a very limited way are lye and bleach, cyanamid, chlorates, and possibly calcium carbide. The total consumption of power for these needs probably would not reach 25,000 horsepower.

The utilization of atmospheric nitrogen for the production of ammonium nitrate is a possibility of the utmost importance for the future of the United States agriculturally, industrially, and for purposes of military defense. A power development of the size proposed for The Dalles could be utilized as soon as available for this industry.

There is a more remote possibility affecting the great stores of phosphate rock in the Northwest which, contingently upon the successful outcome of experimental work actively under way and apparently showing indications of success, may be transformed into ammonium phosphate by the help of electrical power and by this means become available for the uses of agriculture the world over.

LETTER TO THE EDITOR.

Hazards of Electric Heaters and Ranges.

Sir: We note in your edition of June 3 an article written by Mr. G. A. Cleary.

This is a very interesting article, but in the last paragraph on page 436 he makes the statement that the General Electric and the Hughes Electric Company individually fuse the elements of their ranges, whereas the Hotpoint Company and some other companies do not.

We have never put out one of our new type electric ranges without each element individually fused, and we feel we have been done a gross injustice by being classed with the manufacturers who do not fuse the elements of their ranges individually.

We will appreciate a public statement from you correcting this error in Mr. Cleary's article.

Very truly yours,

HOTPOINT ELECTRIC HEATING CO.,

P. H. BOOTH, Vice-President.

Ontario, Calif., June 3, 1916.

INDUSTRIAL PREPAREDNESS.

BY GEO. W. DICKIE.

(In the course of a joint meeting of engineers at Los Angeles on June 3rd, Mr. Dickie, as an associate member of the Naval Consulting Board, spoke briefly on this subject. The following remarks are taken from the concluding portion of his address.—The Editor.)

Many people, some of them industrial producers, do not believe in preparedness and think that the oceans that lie between us and a possible enemy will give time for all the preparation necessary. How many of us realize the distance from Great Britain to the Dardanelles? We are accustomed to think of the Mediterranean as a lake; yet it is 290 miles further from the North Sea to the Dardanelles than from Liverpool to New York. I cannot tell you just how many thousand troops were transported exactly the same distance as from Europe to the coast of the United States, landed and waged a campaign against a powerful and fully prepared nation, but I am sure that it was a far larger force than could be successfully repelled by us in our present state of unpreparedness. Our experts in the War College will tell you that it is an easier problem to move a large body of troops a great distance by sea than by land, that it would take a shorter time to transport an army 3000 miles by sea than to move it from New York to California, and yet there are many who insist on closing their eyes to these obvious facts.

Then we meet other people who believe that we should be prepared, but claim that it is the duty of the Government to make preparations necessary, and thus eliminate the incentive of those who would profit by manufacturing war material to urge the nation to war. These people seem to forget that battleships and army corps of themselves do not constitute preparedness. They forget that even munitions today are only one of the many requisites necessary to success in modern war. We are far away from the time when men followed their chief to battle and the problem was not that of munitions, but of muscle in the hour of strife.

For present day war needs, how many of us realize that to produce the gauges and jigs necessary to manufacture the 200,000 shells daily required by an adequate artillery force in action would swamp the facilities of the three largest plants in this country now making these articles, swamp them from now until the year 1921, and that preliminary item alone would cost \$18,000,000. In the event of even a medium sized war with a first-class power we would need 120 times our present number of machines fitted and instantly ready for munition manufacture. More than that we would need three men sweating in a factory for every soldier or sailor at the front. If we plan for an army of a million men, and that is not big compared with the armies now at war in Europe, we must also plan another army of three million men to supply the necessary things required by the million in the field. Today the Frankford arsenal is the only one we have equipped for the making of field gun ammunition; if it worked night and day for 365 days it would be able to supply just about enough shells for a single

day's shooting, so that in the event of war, to supply ammunition for field guns alone, we would need 365 duplicates of the Frankford arsenal.

Years ago Germany knew how many shells and other mechanical things that were necessary for war, and how many parts each little machine shop in the country could make, and she gave these shops actual practice in making them, so that on the afternoon of July 28, 1914, every concern in Germany that could make munitions was working full capacity on such work, two hours after the declaration of war. Great Britain got ready in about a year. Of course, merely taking an inventory of our manufacturing plants to determine their possibilities in case of war would in itself be useless. These plants must be furnished in advance with all necessary designs and the jigs and gauges for the manufacture of such war material as they are fitted for, and they must be regularly inspected to insure their ability to shift without loss of time from the products of peace to the products of war.

Then our railroads must be ready for the job that war would bring them, should the misfortune of war overtake us. Our 250,000 miles of steel highways would become the very backbone of our power to stand. Yet how little are we prepared to care for the extraordinary quantity of traffic that would be headed for strategic points in that emergency. I would not advocate for our country's railroad tracks to be dedicated to the promotion of war, as Germany did, but I do believe that if our Government would cease considering our railroads as targets for legislative jokes and look upon them as a link, the most important link, in the chain of preparedness, the railroads would soon be able to respond with increased facilities to care for extraordinary needs the Government may have for their service.

In advocating the necessity for preparedness on the part of our manufacturing and producing establishments for the possibility of war demanding the utmost that their plants can produce, I am not one that sees in the near future this country forced to defend itself against a foe seeking a foothold in this country. We have not yet been near to that much dreaded condition. But I can see, not far distant, an industrial struggle in which some of the countries now straining every facility of their industries and working them up to an efficiency hitherto unknown, turning that intensely efficient army of workers on to the arts of peace, and through the power of efficient production they have acquired in this portentous time of struggle and stress, that has brought even their women from the kitchens and offices to the lathes and shaping machines of the factories, in order that they may get possession of markets that we fondly think are ours by right. That invasion, which is not problematical but very certain, needs the same kind of preparedness as the other, and it is the duty of every one who desires to see this country maintain herself as equal to any other people in the world of industry to see that whatever he or she may be engaged in will be prosecuted with the highest obtainable knowledge of the art and the keenest efficiency in practical application of that art.

JOURNAL OF ELECTRICITY

POWER AND GAS

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Several national engineering societies and utility associations are bothered by the apathy of many of their members. With increase in size has come diversity in interest. The present problem is how best to unify these diversities.

In general the problem is an old one, and, in time, works out its own solution. According to an invariable law of nature, centralization is followed by sectionalization as surely as night follows day. Furthermore, the cycle repeats itself, just as in the lower forms of life cells multiply to form aggregates, which in turn break apart into smaller nuclei for new aggregations.

The engineering organism found conditions favorable to growth when the distinction was first drawn between military engineers and civil engineers. Civil engineers became the parents of mining engineers, mechanical engineers and electrical engineers. Each of these divisions became the progenitors of new subdivisions, so that among mining engineers there were coal miners, iron miners and gold miners, each with different difficulties; among mechanical engineers there were steam engine men, gas engine men and hydraulic men, and among electrical engineers there were electrometallurgists, more allied to mining than to electricity, radio experts interested in marine engineering, and generator designers interested in steam turbine progress. Many of these in turn are again specializing along narrower lines, and thus the ramifying process continues indefinitely.

One point of common interest and common convenience to different specialists is the community in which they reside. An electrical engineer is usually more interested in the local solution of a mechanical engineering problem than in the foreign solution of some electrical problem. He can meet locally more conveniently and more frequently. So local engineering societies are in successful operation all over the country, sometimes independently and sometimes as sections of the national societies. But because of natural limitations as to paper sources and financial resources these smaller sections tend to get together as larger geographical sections.

Thus the several Pacific Coast sections of the American Institute of Engineers hold annual get-together meetings, the National Electric Light Association encourages district meetings with other utility associations, and the national engineering societies are conferring with a similar object in view. In this way it is possible to combine the advantages of local freedom with national solidarity.

But in order to accomplish this purpose it will be necessary for the national associations to make certain concessions. By so yielding, they will strengthen themselves, as otherwise the community tie will become stronger than the occupational bond. These concessions include the granting of more adequate district

representation, the allowance of more funds for local activities, and a more personal interest in community affairs. The most liberal body in this respect, and perhaps for this reason the strongest, is the American Institute of Electrical Engineers. The national body pays the expenses of a delegate to its annual meeting from each section, it provides funds for local activities and aims to distribute its officers throughout the country. Yet even the institute has not yet seen fit to arrange for territorial vice-presidents.

This writing is a dispassionate presentation of a subject concerning which most Western men are sensitive. They see the inelasticity, waste and inefficiency of centralized power, they fear bureaucracy and they desire representation. Yet they are not provincial. They are broad enough to think nationally and meet half way those of the East who are also big enough to think nationally about local problems. With greater opportunity for unrestricted local development will come increasing national loyalty. Otherwise, community clannishness will supersede occupational loyalty.

Much of hope and encouragement is found in the doctrine that by means of will power a man can make of himself whatever he wants.

Aptitude

This is the basis of inspirational writing and the belief has been of material benefit to many a man.

No matter how hard the task, it can be brought about by making up one's mind to do it.

Experience has proven that this principle is correct. By the exercise of sufficient will power any man can accomplish wonders in any direction he so desires. Every image that is persistently held in mind is sure to materialize. The men who have moved this world are those who have first brought themselves to a point where nothing was rated too hard as a condition of success. The greater the difficulty, then, the greater is the incentive to overcome it. This is as true today as two thousand years ago, when Demosthenes corrected a natural impediment in his speech and became the greatest orator of his time. Men of purpose accomplish their objects because of will power, willingness to forego personal ease and pleasure in order to win a coveted prize and they count as a delight the self-denial involved.

While the application of the theory that where there is a will there is a way has been responsible for the attainments of great men it has also caused failure on the part of as many others. It fails to take into account that each individual has certain inherent bends along which progress is easier than in other directions. The same will-power and the same energy applied along the lines of natural aptitude will accomplish more tangible results than if directed against natural inclinations.

There are those who teach that salesmen are made

not born. And who is not acquainted with men who might have been fine mechanical designers if they had not become mediocre salesmen. Injudicious use of this argument has put many a square peg into a round hole and caused many a razor to be used for chopping blocks of wood.

Analysis shows that every individual has certain innate characteristics because of which he is better adapted by nature to some tasks than others. How foolish and wasteful, then, is it for him to try to fit himself to some occupation for which he has no aptitude.

Yet that is precisely what our schools are attempting every day, the usual defense being that the training of the mind and of the will power is a sufficient recompense for the time spent in a given subject, even though actual proficiency is not obtained. Under the title of "Aptitude as a Basis for Education" this subject is sanely discussed by Sanford A. Moss, an engineer with the General Electric Company, in the June Bulletin of the Society for the Promotion of Engineering Education. He defines aptitude as "the ability to reach a conclusion without conscious reasoning, and lack of aptitude is the necessity for tediously going through each step in a chain of reasoning and finally deducing the conclusion explicitly."

Every man has some ability in some direction. Aptitude marks the direction of that ability. Mr. Moss argues that the more an aptitude is developed the greater the chance of general success. He admits that by sheer labor almost anything can be acquired, but there never can be true success without aptitude. He shows that concentration, memory, reasoning power and all such general qualities can be developed as well in one way as in another and concludes that general culture and broadness can be imparted by learning about a thing without necessarily learning how to do it.

Consequently he suggests that the apt and the inapt students in any subject be segregated, that the apt be instructed in the actual handling of the tools and that the inapt be taught of the subjects merely as interesting branches of human knowledge concerning which they should have a general understanding without attempting to acquire proficiency.

This suggestion seems reasonable not only as regards college students but all persons in general. With better vocational guidance there would be less industrial inefficiency. In this way it would be possible to mitigate the inexorable law of the survival of the fittest by transferring those who are unfit in one field to an environment to which they are better fitted. By a more scientific selection of employes it would be possible to lessen the annual turn-over of workers and thus increase the annual turn-over of product. Then after a judicious selection of the aptitude, the direction, let the great achievements be accomplished by the exercise of will power.

PERSONALS

Frank Somers of the Century Electric Company of San Jose, Cal., is at Fresno.

A. H. Babcock, electrical engineer Southern Pacific Company, is spending three months off the New England coast.

H. H. Courtright, manager Valley Electric Supply Company, has returned to Fresno from San Francisco.

H. E. Sanderson, Pacific Coast representative of the Bryant Electric Company, returned last week from the Northwest.

S. P. Russell, manager of the electrical department of the H. W. Johns-Manville Company at San Francisco, is at Los Angeles.

G. S. Nickerson, irrigation engineer of the North Fork Ditch Company of Sacramento, was a recent business visitor at San Francisco.

Guy W. Talbot, president of the Pacific Power & Light Company, has been elected chairman of the civic bureau, the Portland Chamber of Commerce.

Wynn Meredith, a member of the firm of Sanderson & Porter, is at Tulsa, Oklahoma, where he is opening a field office to handle oil pipe line construction.

H. J. White, sales agent Keeler-White Company, leaves for the East this week to be gone six weeks or more. He will return via Spokane and the Northwest.

C. R. Hunt, manager of the Robbins-Myers Company at San Francisco, recently returned from a two weeks' business trip throughout the southern part of California.

L. G. Cushing, factory representative of the Connecticut Electric Manufacturing Company of Bridgeport, Conn., is visiting the Pacific Coast, now being at Los Angeles.

Grattan Kerans, who for four and a half years was associate editor of *The Jovian*, official organ of the Jovian Order, on June 1 returned to the editorial staff of the *St. Louis Post-Dispatch*.

W. I. Otis, Pacific Coast agent for the Detroit Fuse and Manufacturing Company and other lines, has returned to San Francisco from the southern part of the state and announces a successful trip.

Ray Murphy, assistant Pacific Coast manager Westinghouse Lamp Company, has recently returned to San Francisco from an extended business trip to Los Angeles and Southern California.

B. J. Klein, Pacific district manager of the Bristol Company of Waterbury, Conn., will return to San Francisco the first part of the week from an extended business trip throughout the Northwest.

A. J. Myers, Pacific Coast manager of the Wagner Electric Company, is expected to return to San Francisco from a three-week business trip throughout the southern part of California about the end of the week.

J. W. Meek, formerly Pacific Coast manager for the Bessemer Gas Engine Company, now connected with W. J. Wallace and his associate companies at Los Angeles, was a recent visitor at San Francisco.

Franklin T. Griffith, president of the Portland Railway, Light & Power Company, has returned from a trip east to confer with the other member of the executive committee, of which C. M. Clark is chairman, at Philadelphia.

John Hunt, purchasing agent of the Pacific Gas & Electric Company, and **John D. Kuster**, San Jose manager for the same company, have just returned from a trip East by way of New York and Washington, having stopped at the N. E. L. A. convention.

N. Abrams, president of the Western Agencies Company of San Francisco, has returned from the southern part of Cali-

fornia and reports good business. He has established a branch office of the Western Agencies Company at Los Angeles.

W. C. Wurfel, Pacific Coast manager Westinghouse Lamp Company, has returned from a trip to Eastern cities, visiting the various lamp factories; participating in the annual meeting of district managers of his company at New York; and attending the Chicago convention of the National Electric Light Association.

Eugene V. Griffes has resigned as secretary and general manager of the Oceanside Electric & Gas Company, of Oceanside, Cal., with the acquisition of the company by the San Diego Consolidated Gas & Electric Company, for whom **A. S. Glasgow** will act as resident manager at Oceanside. Mr. Griffes incorporated and designed the equipment for the Oceanside company in 1904, since which time he has had charge of the company's affairs. He will leave Oceanside in July and make his home at Pasadena and Point Firmin, Cal.

W. H. Clarke, manager of the bond department of H. M. Byllesby & Company, has returned to the Chicago office from an inspection of the utility properties in which his firm is interested in California. It was Mr. Clarke's first visit to California and he is decidedly optimistic on the prosperity of that state in the immediate future. "The banks of the cities are carrying large balances," he says, "and many development plans are in motion which promise gratifying results. No one can come away from California without a deep impression of the energy and creative and productive ability of the people of that state. The public utility properties in which we are interested, namely the San Diego Consolidated Gas & Electric Company, and the Western States Gas & Electric Company which serves communities centering at Stockton, Richmond and Eureka, are doing splendidly. They do business in territories which are both stable and growing, and have succeeded admirably in pleasing the public. The people of San Diego have responded cordially to the opportunity to invest in the new preferred stock of the San Diego Consolidated Gas & Electric Company and the patrons of the Western States Company are to be offered the securities of that company soon."

OBITUARY.

E. N. Fobes, president of the Fobes Supply Company of Seattle and Portland, was killed by the capsizing of his automobile near Noyesburg, Sutter county, California, on the morning of June 5. Mr. Fobes was making an automobile tour throughout California. He was well known to all electrical supply men on the Pacific Coast and his accidental death comes as a severe shock to his many friends.

A. D. Houghton, a prominent mechanical engineer, died at Santa Cruz, Cal., June 5, aged 51 years. Before coming to California ten years ago Dr. Houghton was in the employ of John D. Rockefeller, and was architect and builder of the Rockefeller Hall Library. He also designed the heating and electric light plants of the University of Chicago, the power plant and water system of Bryn Mawr College and the heating plant at Wellesley College. During the Spanish-American War he entered the naval service as assistant engineer at Boston Navy Yard. He is survived by a widow, two sons and a daughter.

TRADE NOTES.

The Power Equipment Company has moved from their quarters in the Rialto Building to 405-407 New Call Building, San Francisco.

The Central Electric Company of San Francisco has secured the wiring and equipment contract for the Old City Hall on Eighth and Market streets. The building is seven stories and covers about 220 by 137½ feet.

A. S. Lindstrom, Pacific Coast manager of the Thordarson Electric Company; R. E. Frickey and H. M. Bloch have recently combined and formed a company known as the "Efficiency Products Company." The first product that they expect to put on the market will be the Epco Electric Water Heater for household purposes to be installed in connection with electric heating and cooking appliances.

MEETING NOTICES.

San Francisco Electrical Development and Jovian League.

With Mr. Percy Pitts of the Pacific Gas & Electric Company as chairman of the day, the League luncheon of May 31st combined much of pleasure and profit. Mr. Pitts introduced Mr. C. E. Grunsky as the principal speaker, Mr. Grunsky telling, in a most interesting manner, of his personal experiences as a member of the first Panama Canal Commission. His account brought home to all the stupendousness of the task and the wonder of the accomplishment. Announcement was made of rapid progress in perfecting plans for a great joint Jovian rejuvenation at Trestle Glen, Oakland, on the night of June 10th, both San Francisco and Oakland joining forces in what promises to be the most spectacular affair of its kind ever held.

Joint Engineering Meeting at San Francisco.

A joint meeting of the members of the various national engineering societies was held at the Engineers' Club, San Francisco, on the evening of June 2. Brief addresses were made by the local chairman of each society as well as by President Bumsted of the club, he congratulating the members on their ability to assemble thus harmoniously on neutral ground. Mr. A. V. Thompson of the General Electric Company gave an interesting lantern slide talk on "The Electrification of the Chicago, Milwaukee & St. Paul Railroad," the first instance in which electric haulage of through freight and passenger trains on a large steam railroad system has been accomplished primarily to effect a saving in cost of operation. The high cost of coal throughout the entire 440 miles of electrification and the low cost of hydroelectric power under similar conditions is expected to bring about a great saving to the St. Paul, judging from the 36 per cent saving in operation shown in the first year of electric operation of the Butte, Anaconda and Pacific.

The 42 locomotives are hauling 15,000 tons per day east bound and 10,000 tons per day west bound over the transcontinental divide. The freight and passenger locomotives are identical except in gear reduction being 4.56 and giving a speed of 16 miles per hour when hauling a 2500 ton trailing load on 1 per cent grade with the freight locomotives and 2.43 with the passenger giving a speed of 30 miles per hour with an 800 ton train on a 1 per cent grade. The locomotives consist of two 4-wheel bogie truck units, there being 8 drivers and 8 1500 volt motors, arranged two in series. Direct current is delivered at 3000 volts to the locomotives from an overhead trolley supplied by the Montana Power Company through a total of 14 substations, spaced at an average distance apart of 32 miles, the total substation capacity for the 440 miles of track being 59,500 kw., or about 15,000 kw. for a division.

By means of regenerative braking each motor acting as a generator, a 3000 ton double-header can be dropped down a 2 per cent grade at a uniform speed of 18 to 20 miles an hour without the application of air brakes and also returning power to the system. This return amounts to an average of 14 per cent and a maximum of 40 per cent of the power used. The saving in brake shoes and wheel wear is almost as important as the saving in power.

The approximate cost of the electrification was \$11,100,000, of which the 42 locomotives represented \$1,800,000, the 14 substations \$1,800,000, the trolley and feeder system \$3,600,000, and the transmission line \$1,200,000.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Plumas Light & Power Company, Plumas county, has applied to the commission for authority to issue bonds to refund its outstanding indebtedness and to make extensions and betterments. The improvements are estimated at \$7650.

The commission has authorized the Southern Counties Gas Company of California to purchase the gas properties of the Southern California Edison Company, and of the Long Beach Consolidated Gas Company. The Southern Counties Company pays \$1,050,000 for the Edison Company's properties and \$950,000 for the Long Beach property. The commission also authorized the Southern Counties Company to issue \$2,500,000 20 year 5½ per cent bonds and \$660,000 6 per cent preferred stock. The sale of bonds and stock will net \$3,000,000.

The Los Gatos Telephone Company has applied to the commission for authority to issue capital stock of par value of \$1500 to pay note held by Bank of Los Gatos.

The Pacific Telephone & Telegraph Company and the Sunset Telephone & Telegraph Company have filed a joint application with the commission for authority for the Sunset Company to sell to the Pacific Company all its property and assets in California. Consideration of sale, \$10. Capital stock of Sunset Company is \$15,000,000, all owned by the Pacific Company.

The California Telephone & Light Company, with its principal office in Santa Rosa, has applied to the commission for authority to issue and sell \$25,000 face value of its first mortgage 6 per cent gold bonds, maturing in 1943, at not less than 94 per cent.

The commission has authorized the Reedley Telephone Company to issue 951 shares of its capital stock at \$1 par value at not less than 90, to reimburse treasury for moneys expended.

The Martinez and Concord Interurban Railway Company has filed with the commission a second amended application changing the route of its line, and for authority to issue and sell 600 shares of its capital stock at \$80 per share and \$125,000 face value of its first mortgage bonds at 90 per cent.

The commission has authorized the San Diego Consolidated Gas & Electric Company to buy on or before September 1, 1916, the entire issued capital stock of the Oceanside Electric & Gas Company, 1819 shares, at \$14 per share.

The commission has authorized the San Francisco-Oakland Terminal Railways to issue \$180,000 of 6 per cent equipment notes to pay in part for 32 new railway cars. The notes are to be in denominations of \$500 and \$1000 to be callable at 100½ on 60 days' notice and to mature at the rate of \$10,000 every six months beginning May 1, 1917.

The commission has authorized the Corona Gas & Electric Light Company, operating in the city of Corona, Riverside county, to execute a first mortgage on its properties as security for an issue of \$58,500 6 per cent 50 year bonds.

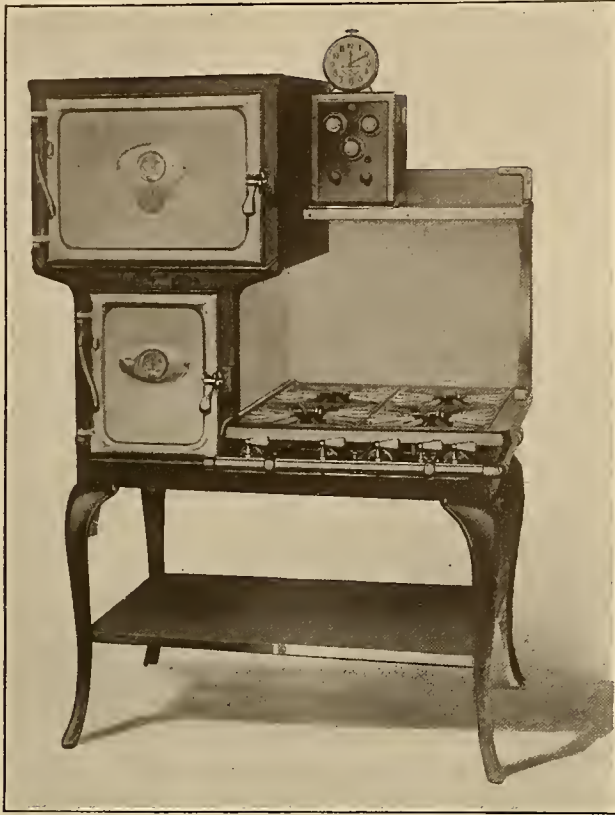
The Western States Gas & Electric Company has filed with the commission an application for approval of expenditures for plant improvements of \$10,759.17.

The Santa Maria Gas & Power Company, which furnishes natural gas in Santa Barbara and San Luis Obispo counties, has filed with the commission an application for authority to issue \$40,000 par value of its 6 per cent gold bonds, at par and accrued interest, the proceeds to pay in part for the construction of a distribution system in San Luis Obispo.

The Lindsay Home Telephone & Telegraph Company, of Lindsay, Tulare county, has filed with the commission an application for authority to issue \$15,000 of 6 per cent 18 year bonds, at 93, to execute a deed of trust to secure this amount, and to adjust its rates.

COMBINATION GAS AND ELECTRIC RANGE.

In the new line of electric ranges now being placed on the market by the Westinghouse Electric & Manufacturing Company is a novel type, in which the four stove top electric heaters have been replaced by four gas burners. This makes possible the use of gas on top of the stove and electricity for the oven. In the center of the four burners is an automatic



Westinghouse Combination Gas & Electric Range.

gas lighter, controlled by a button valve in the front of the stove.

The oven equipment of the combination range is identical with that in the Westinghouse standard type of electric range, a large oven 18½ by 13½ in. by 16 in. deep, requiring 2000 watts and a smaller oven 10¾ by 13½ in. by 11½ in. deep, requiring 850 watts. Three indicating switches are provided for oven heaters. A one-oven range is also manufactured, requiring 2000 watts. Automatic time and temperature control is provided.

ELECTRICAL BASEBALL LEAGUE.

Standing of Clubs.

	Won.	Lost.	Per Ct.
Pacific States Electric Co.....	6	0	1000
Western Electric Co.....	4	2	.666
Electric Ry. & Mfg. Supply Co.....	2	4	.333
Electric Appliance Co.....	2	4	.333
General Electric Co.....	1	5	.166

June 3rd Results.

Elect. Appliance Co.....	8	Pacific States Elect. Co.....	9
General Electric Co.....	2	Western Electric Co.....	4

No other game scheduled.

Electric Appliance Company vs. General Electric.

The Electric Appliance Company defeated the General Electric Company in one of the fastest games of the season by a score of 7 to 2. Pitcher Long of the Electric Appliance Company kept his hits well scattered, where Pitcher Wiseman of the General Electric Company was unfortunate in having them bunched in the sixth inning, when six runs were scored by the winners. The feature of the game was the playing of Keck at first for the Electric Appliance Company, accepting a number of wild throws, in connection with mak-

ing a double, unassisted. The game was played in the remarkably short time of 1 hour and 25 minutes.

Pacific States vs. Western Electric.

One of the best games of the season was played last Saturday afternoon, when these teams crossed bats. The game was full of exciting moments, as both of the teams are on top in the race for the beautiful trophy which the Electrical Baseball League has put up for the team finishing first at the end of the season, which is scheduled for July 29, 1916.

The fans watching this battle were kept awake every minute of the game, as the heavens of both teams got in some tight places, but O'Connell of the States showed his superiority when he struck out two men with two on the bags. A pretty double steal was enacted in the fourth inning by Markowitz and Kennedy of the States. Lorgan of the Western Electric drove a nice one out to centerfield, which seemed to start a rally in the second inning, and allowed two runs to come in, leaving the score two to four in favor of the Western Electric. Kahn, the States star first baseman, came through with a beautiful bingle in the fourth inning and just at the right time, which started the rally of the inning, in which five runs were brought over the rubber.

The Western Electric boys tried hard to redeem themselves in the remaining innings; several of them hit the ball, but, alas! Good fielding found them put out before reaching the bag.

The game was called at the end of the sixth inning on account of the lateness of the hour, with the States again defending their title as league leaders, with a score of nine to four.

NEW CATALOGUES.

Crocker-Wheeler Nine-Inch Fans are illustrated and described in a recent circular.

"Better Industrial Lighting" is the subject of a new booklet which has been prepared by the publications committee of the National Electric Light Association, to be purchased by electrical companies for distribution among lighting prospects. The arguments are convincing and the illustrations of good lighting practice are right to the point.

A NEW TRANSFORMER OIL.

Lectroseal (L. S.) oil is a new grade of insulating transformer oil recently introduced by the Westinghouse Electric & Manufacturing Company. This oil has its chief application as an insulating and cooling medium for use with all classes of oil insulated distributing and power transformers. It is also used with such apparatus as induction type feeder regulators and electrolytic lightning arresters.

Lectroseal is a pure mineral oil, obtained by the fractional distillation of petroleum and is free from moisture, acid, alkali and sulphur compounds. As an insulating medium, it has a high dielectric strength. The average breakdown test is said to be 40,000 volts on a .15 in. gap between spheres ½ in. in diameter. As a cooling medium, it is claimed that this is particularly well adapted, the viscosity being very low (approximately 36 at 40 degrees C. Saybolt method.) Consequently, the oil will circulate rapidly and transfer the heat quickly from the transformer or other apparatus to the walls of the tank. If water should accidentally enter a transfer tank, it should sink to the bottom of the tank as quickly as possible, as a small percentage of water thoroughly mixed with the oil reduces its dielectric strength very rapidly. Various grades of oil differ greatly as to their ability to separate from water with which they have been mechanically mixed, but Lectroseal oil, it is claimed, possesses this quality in a marked degree.

The other characteristics claimed for Lectroseal oil, such as freedom from deposit, satisfactory flash and fire point, low rate of evaporation and light color, would indicate that this is practically ideal for the purpose for which it is intended.



NEWS NOTES



ILLUMINATION.

SANTA BARBARA, CAL.—Concrete posts are to be used for the ornamental lighting system on State street.

PASADENA, CAL.—The city commission has ordered the construction of underground conduits in Lester avenue with appurtenances for carrying light, power and other wires.

SAN DIEGO, CAL.—The bid of B. Rose & Company for the installation of electric lighting equipment on Fourth street between E and G streets has been accepted by the city council at \$2042.

RIDDLE, ORE.—A. E. Brais has formally accepted a franchise providing for an electric light and power business here. Mr. Brais has just completed estimates of cost of material, etc., and construction work is to start on the system soon.

RIVERSIDE, CAL.—Protests will be heard on June 13 regarding the proposed improvement of Highland Place between Brockton avenue and Suman Tract, by the installation on each side of the street of electric poles, conduits and lamps.

WALLACE, IDAHO.—The city council has authorized the installation of a system of incandescent lighting throughout the city, outside of the district now lighted by the cluster system. Installation will be started as soon as material can be secured.

POMONA, CAL.—The city council has ordered the construction of concrete posts, wires, conduits, lamps and appliances for street lighting purposes in Alvarado street, Columbia avenue, Lincoln avenue, and certain other streets in conformity with plans on file with the city engineer.

COEUR d'ALENE, IDAHO.—Immediate steps toward the construction of a new light and water plant to be owned and operated by the municipality, or the purchase of the present plants furnishing light and water to the city was recommended by the fire, light and water committee of the city council.

POMONA, CAL.—Immediately upon assuming control of the local gas business which it is purchasing, the Southern Counties Gas Company will remodel the plant. Old machinery will be removed, and new equipment installed. The next move will be to connect the gas mains of Covina with those of Glendora and Azusa. The Covina plant will then either be used as a relay station or else abandoned.

PHOENIX, ARIZ.—Petitions to initiate an ordinance to authorize the purchase or erection of a gas and electric plant here will be started in circulation within a few days. The present plan is to issue bonds in the sum of \$600,000. The city engineer has submitted figures showing that it would cost about \$840,000 to build a new plant thoroughly equipped. It may be decided to purchase the plant of the Pacific Gas & Electric Company.

TRANSMISSION.

VENTURA, CAL.—The Ventura Light & Power Company is getting ready to install at a cost of about \$10,000 two substations in this district. Work will begin at once.

LAGUNA BEACH, CAL.—Officials of the Pacific Light & Power Company have announced that within the next few months they propose to erect a power line to Laguna from Newport Beach.

LAKEPORT, CAL.—At the annual meeting of the directors of the Mt. Konocti Light & Power Company, announcement was made that the company is extending its power line to Saratoga Springs and up Middle Creek to Lyman's, and also figuring on extending the line to Blue Lakes and Laurel Dell.

FALL RIVER MILLS, CAL.—The California Power & Manufacturing Company is using every effort to get its irrigation system into service for use during the present season. About 60 miles of wire have been strung to furnish power to flour mills and ranches throughout a large section of Shasta county. The irrigation plant will cost approximately \$50,000.

QUINCY, CAL.—The Great Western Power Company has acquired possession of the Humbug Valley property formerly owned by the Oro Electric Corporation, according to announcement made here. The property will be used by the Great Western in the development of the series of great power plants. It is proposed to divert the water by a long series of tunnels, flumes and concrete ditches from the Big Meadows dam to Humbug Valley, where it will be dropped to the North Fork of Feather River to the new power plant. The ultimate construction cost of the new system of water supply and the new power plant will be approximately \$25,000,000, according to officials of the company.

TELEPHONE AND TELEGRAPH.

WENATCHEE, WASH.—The Bell Telephone Company will rebuild its lines between Waterville and Pateros and Oroville and Molson this summer.

SAN DIEGO, CAL.—Improvements in the local system of the Pacific Telephone & Telegraph Company, involving an expenditure of \$25,000, will be started immediately according to the local manager.

BELTON, MONT.—The Northern Idaho & Montana Power Company has completed a telephone line between Columbia Falls and Belton, the western gateway to Glacier National Park, and to Lake McDonald, one of the resorts in the Park. This line will carry considerable business during the tourist season.

FRESNO, CAL.—Authorization for the expenditure of approximately \$36,000 to enlarge the service to take care of the new districts, to place wires underground and to make general improvements in towns near Fresno has been made by the general office of the Pacific Telephone & Telegraph Company, and it is thought that the work will be finished within the next eight months.

IRRIGATION.

SAN JOSE, CAL.—Property owners interested are organizing the Laguna Seca Reclamation District near Coyote (about 12 miles south of San Jose) Santa Clara county, California. The District will embrace about 1200 acres of lands, which have been more or less overflowed in the past, and embracing the Laguna Seca. Plans for the drainage canals (about 4 miles in length) are being prepared. The work will embrace about 100,000 cubic yards of earth excavation, also bridges, gates, culverts, etc. Bids will be called for early in July. Duryea, Haebl & Gilman, Humboldt Bank Building, San Francisco, are the engineers.

SALEM, ORE.—The Desert Land Board has received notification that the Department of the Interior had granted the state's application for a five years' extension of the state's contract with the government for the completion of the Morson Land Company's project near La Pine, in Crook county. This project is known as Oregon segregation list No. 11 and comprises 27,000 acres. The granting of the extension to the state will result in the state granting the Morson Land Company an equal extension on its contract with the state and will mean, it is said the immediate pushing to completion of the west unit of the project, comprising about 10,000 acres. To complete the west unit will cost about \$10,000.

ALPHABETICAL INDEX TO ADVERTISERS

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Los Angeles; 755 Folsom St., San Francisco; Seattle.
- A-2 Atchison, Topeka & Santa Fe Railway Co.....
673 Market St., San Francisco; 1218 Broadway, Oakland.
- B-1 Baker-Joslyn Company..... 3
71 New Montgomery St., San Francisco; 911 Western
Ave., Seattle; 353 E. Second St., Los Angeles.
- B-2 Benjamin Electric Manufacturing Co.....
590 Howard St., San Francisco.
- B-5 Bridgeport Brass Co..... 4
(See Pierson, Roeding & Co.)
- C-1 Century Electric Co..... 12
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- E-7 Economy Fuse & Mfg. Co.....
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- E-3 Electric Agencies Co.....
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- W-5 Westinghouse Machine Co.....
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- W-6 Westinghouse Lamp Co.....
(See Westinghouse Electric & Manufacturing Co.)
- W-8 Western Pipe & Steel Co.....
444 Market St., San Francisco; 1758 North Broadway,
Los Angeles.

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PROSPECTIVE MARKET FOR IRRIGATION PUMPING.

BY JOSEPH JACOBS.

DISTRIBUTION OF POTENTIAL ABOUT HIGH VOLTAGE LINE INSULATORS.

BY CHESTER T. ALCUTT AND W. K. SKOLFIELD.

REPORT OF N. E. L. A. ELECTRIC RANGE COMMITTEE.

FAULTS OF NATIONAL ELECTRIC SAFETY CODE.

BY R. J. McCLELLAND.

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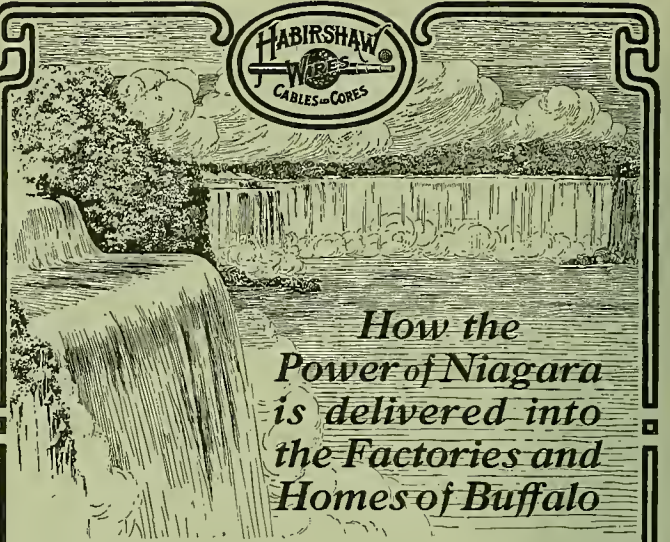
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PROSPECTIVE MARKET FOR IRRIGATION PUMPING

BY JOSEPH JACOBS.

(While this report refers specifically to the Celilo power development at The Dalles, Oregon, as a power source, its conclusions apply to many irrigation projects throughout the West. The report constitutes Appendix L of the Report on the Columbia River Power Project, which is being printed in full in these columns. The author is consulting engineer with the U. S. Reclamation Service.—The Editor.)

Purpose and scope of investigation. The reason for undertaking the investigation herein dealt with was to ascertain to what extent irrigation pumping might demand electric power from the proposed power development at Celilo Falls on the Columbia River.

tion, aided by the best maps available and by the use of ordinary hand instruments such as the aneroid barometer and the hand level. I was assisted in this work by D. S. Hays, who was continually in the field during the months of May, June and July.



The Three Sisters in the Cascade Mountains, which Range Deprives Eastern Oregon and Washington of Rainfall, thus making Irrigation Necessary.

Its primary purposes, in other words, was to determine the extent of this power demand and not to make any critical examination of the irrigation projects themselves, though it was, of course, necessary that these projects be examined sufficiently to reasonably establish their feasibility or the reverse. To this end all the projects named as feasible in this report, and many others which were finally rejected as infeasible or as not economically dependent on Celilo power, were examined on the ground, and while no definite surveys were made, their essential physical elements were determined as fully as this could be done by field inspection.

So far only as the immediate field work is concerned, the territorial scope of this investigation was confined to the arid and semi-arid districts along the valley of the Columbia River and its primary tributaries in Oregon and Washington, exclusive however of central Oregon and of that portion of Washington lying north of the main line of the Great Northern Railway. The writer's familiarity with the districts last named, as a result of field examinations made by himself during the past few years, relieved the necessity for their detailed field inspection at this time, and especially so in view of every indication that, to the

extent that opportunities offer for irrigation pumping in these districts, these can be more economically served from sources of power other than that herein contemplated.

Having in mind the element of time and the fact that the end sought in this inquiry is a quantitative expression of the probable irrigation power demand on the proposed Celilo development, it is necessary that this report confine itself rather rigidly to a discussion of those features which tend directly toward that end, including, of course, brief descriptions of most of the irrigation projects involved.

Topographic situation. The dominant topographic feature, and that of first significance for the region under consideration, is that the Columbia River, which constitutes at once the main water supply and the drainage of the region, flows between high bluffs and on low gradients for the greater part of its length within the states of Washington and Oregon and until it emerges from the Cascades just east of Portland. This canyon-like feature even more markedly characterizes the Snake River from its confluence with the Columbia at Pasco to the eastern boundary of Washington, at Clarkston. There are but restricted areas of bottom land along these rivers, but upon the slopes of their confining walls and particularly upon the adjacent bench or plateau, at heights varying from 100 ft. to 600 ft. above the river, are excellent bodies of fertile land requiring only the application of water to render them productive. The gradients of these rivers are so flat, ranging from 1 ft. to 3 ft. per mile, and the main bodies of irrigable land are so high above the rivers as to render gravity canals from that source entirely impracticable. Gravity water supplies from other sources are also, with few exceptions, unavailable to these lands because such supplies are either now fully appropriated and utilized or they are economically more applicable to other lands. Pumping from these great rivers therefore remains the only practicable means of redemption of these areas from permanent aridity.

Sources of water supply. As stated in the previous paragraph, the chief source of water supply for the projects herein considered must forever be the Columbia River. Consideration was given to other streams, as the Snake and Yakima Rivers, and to ground waters, but these sources are in nowise comparable to the Columbia. The fact is, that so little is known of ground water supplies in Oregon and Washington that but little reliance can be placed upon them as fertile fields for power demand on the Celilo development. This is true not only because of our limited knowledge concerning the location of such supplies, but also, so far as they are known, because of their generally restricted yield and of their distance from the proposed source of power. There are of course possibilities of pumpage from shallow wells far greater no doubt than we are now aware of, but however valuable these may prove to be in the general scheme of agricultural expansion their aggregate power consumption will be so small in comparison with the larger pumping projects as to have but little present bearing upon the feasibility of the proposed Celilo development. Some

of these shallow well pumpage possibilities will be referred to further on in this report.

Irrigation by means of deep well pumps in this district is as yet comparatively new, and in its experimental stage. A few such plants have been installed, as for instance on the Horse Heaven plateau and in the Quincy Valley district in central Washington, but neither economic operation nor an abundant water supply has yet been proven for either of these districts. Both of these implied causes will, in my opinion, operate to prevent any important power demand from that source. Other ground water possibilities for pumping are from springs and artesian supplies, but these too are destined not to create a great power demand—primarily because of their scarcity, but also because they may usually be applied to the land without recourse to pumpage.

Feasibility of projects. The projects herein considered must be studied not only with respect to their inherent feasibility as individual pumpage developments, but more particularly with respect to their relation to the proposed Celilo development from which source it is intended they shall derive their power. Even though a highly attractive pumping project may be evolved on the basis of using Celilo power, such a project should be excluded from final consideration if there is assurance of cheaper power being supplied from some other source. In other words, due weight must be given to the element of competition with other power, whether electric or of other form, and also to that of competition with gravity water supplies, where such alternatives offer.

Feasibility with respect to time will depend upon the rapidity with which cheaper gravity projects are developed and successfully colonized, and in considering this feature we must contemplate this entire Northwest territory and to a certain extent the entire Pacific Coast. Unquestionably, the establishment of trade routes through the Panama Canal will induce a rapid increase of immigration to this coast. This in turn will induce a keen demand for agricultural lands and will compel the early development of many irrigation projects, but until the better gravity schemes have been absorbed, whether these happen to be in Idaho, in Oregon or in California, it will be difficult to successfully colonize the higher priced pumpage lands.

There will of course be an immediate demand for those lower lift pumpage schemes which are economically comparable with the better class gravity schemes, but the higher lift schemes must in my opinion await the consummation above indicated, and moreover their success and feasibility depend also upon the careful working out of a scheme of finance that provides for long deferred final payments and easy terms to those who purchase and settle upon the land. Failure to take cognizance of these factors would result in overestimating the real irrigation demand that is likely to be put upon Celilo power, and to that extent would be misleading.

Pumpage and gravity schemes compared. Gravity irrigation is generally more economical, and heretofore has been more reliable than pumpage irrigation, as a result of which pumpage irrigation has been resorted



Typical View of Snake River Canyon Between Oregon and Idaho.

to only when gravity supplies were not available. This is evidenced in the records of the last national census, which shows that the total irrigated area of the United States in 1909, was 13,738,485 acres, of which but 477,623 acres, or 3.5 per cent, was served by pumping schemes. The record also shows that this acreage was served by 15,803 individual plants, pumping against an average lift of 37 ft. and requiring 361,480 horsepower of power plant capacity for their operation, of which about one-third was applied to rice land irrigation in the southern states and two-thirds to general western irrigation. It is seen then that irrigation pumping has not yet assumed large proportions in the United States and that thus far it has generally been confined to small developments and low lifts. Examples of comparatively high lift schemes, however, are not wanting, and unquestionably we are now entering upon an era of larger projects and higher lifts for pumping schemes.

One of the usual chief advantages of a pumping plant is the immediate proximity of the pumping plant to the land, thus at once eliminating the feature of a main supply canal with its considerable seepage and evaporation losses and the initial cost and continuing maintenance of which constitute an important element in the economics of gravity schemes. Considering the best modern pumping machinery in comparison with the operation of long main canals, the matter of reliability of service may largely be eliminated and the final selection of the alternative of gravity or pumpage scheme must rest on the criterion of annual cost. Annual power cost is the chief disadvantage of a pumping project, and the price of power

must indeed be low to render the ordinary pumping plant as economical as the ordinary gravity plant. With few exceptions, the alternative of gravity or pumpage supply is not offered with respect to the projects herein considered, and unless a feasible scheme of pumping (and that means cheap power) can be developed the major part the lands will forever remain waste and arid.

Present power costs. The more common form of contract for supplying electric power for irrigation pumping in the Columbia River Valley provides for the payment of a fixed charge of \$12 per annum per h.p. of connected load, plus a rate varying with the amount of power used from \$3 to \$5 per month per h.p. of maximum demand, which for rated capacities up to 5 h.p. must

equal the connected load, and for rated capacities over 5 h.p. must be not less than 75 per cent of the connected load. Some contracts also provide, in lieu of a flat rate per h.p. per month, a graduated meter rate which varies from .5 cents to 3 cents per kw.-hr., the

three-cent rate applying to the first 30 kw.-hr. per rated kilowatt of connected apparatus and the one-half cent rate applying to all power in excess of 420 kw.-hr. per rated kilowatt of connected apparatus. Still another contract provides for the payment of a fixed charge of \$3 per month per kilowatt-ampere of connected apparatus plus .5 cent per kw.-hr. of power consumed, with mini-

mum charge of \$12 per kilowatt-ampere per annum.

These various rates, as applied to different connected loads up to 1000 h.p. and on the assumption of six months of continuous pumping at rated capacity, equate to a kw.-hr. rate of from 0.93 cents to 1.37 cents per kw.-hr. of actual power consumption. In



Snake River Near Coon Hollow Damsite.



Salmon River.

practically no irrigation pumping projects however are the units so arranged as to permit of the conditions such as to require continuous pumping at rated capacity of the machinery installed, and the actual final cost of power on a straight kw.-hr. basis would therefore be in excess of the figures above named. This is particularly true of small individual plants where the actual pumping time may be as little as one-half or one-third of the total irrigation season, a large head of water being thus provided which permits a rapid irrigation of the land. Such an arrangement is often desirable, not only because the land may require that character of treatment, but also because the water user may prefer thus to conserve his own time even though it involve an increase in cost of power.

I have been able also to secure the rates as well as the actual cost of power for a number of the larger irrigation pumping projects along the Columbia River and, on the basis of actual power consumed during the irrigation season, I find these rates to have varied from 0.855 cents per kw.-hr. to 1.53 cents per kw.-hr. On the whole I think it conservative to say that present power rates for irrigation pumping will approximate 1 cent per kw.-hr. of actual power consumed for the larger plants, and 1½ cents per kw.-hr. of actual power consumed for the smaller plants, i. e., for plants of less than 25 h.p. capacity.

The validity of the Oregon water code has been upheld by the U. S. Supreme Court in the case of the Pacific Livestock Company versus the Oregon Water Company. The Livestock Company had alleged that the code deprived it of its property in violation of the fourteenth amendment of the constitution.

The postal savings act has been amended so that interest will be paid deposits up to \$1000 instead of only \$500, as has heretofore been the case. The \$100 limit for deposits in any calendar month has also been removed.

REPORT OF N. E. L. A. ELECTRIC RANGE COMMITTEE.

(Continued.)

Some Suggestions Regarding Range Construction.

Many practical and useful suggestions have been gathered from those who have had experience in the electric range business and the more important of these suggestions are given hereunder. It is likely that their consideration may be of advantage to manufacturers and central stations alike.

Electric ranges should be built as nearly as possible to conform to types of gas ranges now in use. As electric ranges are necessarily more expensive, the additional investment required to make them much more substantial than the average gas range is something which is of little consequence. The small additional investment would add very considerably to the life of the range and consequently the average yearly cost to the customer would be lessened and thus more nearly meet the cost of the gas range.

The more ranges there are in use, the more desirable becomes the installation of the pilot lamp. Only the most careless cook or servant would leave any switch closed when the circuit is not in use, if a lamp or other indicating device were there at the level of the eye to remind her of the fact.

Rotary snap switches controlling the service to various heaters should have a distinctive feature either in color or position of indicator or both, when current is off. The distinctive feature at the present time on most of these switches is the reading of the word "off" but in a dim light or when the eye sight is not of the best, reading is not always easy. A distinctive color for the lettering of the word "off" or the uniform or distinctive position for the indicator will quickly convey the idea to the operator whether or not the circuit is disconnected, even if only a hasty glance is given. Complaints regarding the size of bills are generally caused not by the use of energy but by its abuse or waste.



Twin Falls of Snake River.

For general designs and capacities of ranges the following suggestions are valuable, presuming only three types of ranges are selected:

- 1 Three discs and low oven similar to the Westinghouse 2-18.
- 2 Three discs and high oven similar to the General Electric S-2.
- 3 Four discs, side oven and warming oven, similar to the Hughes No. 50 and Hotpoint D.

The features essential in any standard range are:

- (a) Reliable heating elements that may be easily, quickly and cheaply renewed.
- (b) Easily cleaned oven, with substantial tight-fitting drop door.
- (c) Dependable oven thermometer.
- (d) Some provision for broiling.
- (e) Substantial and durable construction of the range frame.
- (f) Attractive finish (plenty of white enamel and nickel finish).
- (g) Non-rust ovens.
- (h) Terminal contacts to be installed so that troubles from this source may be as far as possible eliminated. There is much room for improvement in this direction.
- (i) Separate fuse plugs on ranges.
- (j) Cooker pots are desirable.
- (k) Crumb trays have distinct advantages.
- (l) One or two plug outlets on the range for attaching a percolator, toaster or other small appliance; these outlets should be separately fused.
- (m) Ovens should not be less in size than 12 by 16½ by 18. They should be well insulated, even in the cheaper ranges.

Burners and Utensils.

The question as to types of burners and the proper kinds of utensils to use with the different types of burners is one concerning which there has been much discussion and a great deal of testing, and, in some respects, the testing and discussions have not reached conclusions which are entirely satisfactory.

There are two distinct types of electric heating elements or burners—disc and open coil. Of the open coil, there are two kinds—coils placed in grooves in moulded blocks and coils supported by a steel frame and insulated by means of mica or porcelain. One manufacturer is making removable reflectors to be placed underneath the open coil and it is claimed that this combination will considerably increase the economy by concentrating the heat rays upon the cooking utensil.

The representatives of two manufacturers, one using enclosed units and the other open coil units, state that their burner will now average 5000 hours of actual use. In other words, the average life of their units in use in the home will be approximately seven years. Further, it requires the enclosed type of burner to operate the cooker pots and this feature on the electric range is economical and has some distinct advantages.

It cannot be denied that the open coil type of unit appeals to the housewife because she can see the glowing coils. When she snaps the switch of this type of unit, there is a quick response and the heat is immediately apparent.

Regarding the most desirable utensils to use with the different types of burners, one of the advantages of the open coil unit is that the average utensil, in the average used condition, such as is found in the

average home, will give the highest economy. In other words, a dish with a dull surface will absorb the radiant heat rays from the open coil unit to the best possible advantage.

With the disc or enclosed type of burner, it is apparent that the utensils should be smooth, flat and have a thoroughly cleaned surface so as to make a good contact and obtain the best possible efficiency.

Apparently it has been definitely decided that the disc or enclosed type of burner will give better results if aluminum utensils are used and that, with the open coil type of burner, the enamel ware utensils seem to give the most satisfaction. The ordinary utensils used on a gas stove can be used on an electric range whether open coil or enclosed type. As the open coil burner more nearly resembles the gas burner, it naturally follows that the ordinary kitchen utensils used on the gas stoves are more likely to operate with greater efficiency on the open coil burner than on enclosed or disc type burners.

Advantages of Electric Cooking.

When a consumer is approached by a salesman with the idea of creating an interest in electric cooking and the installation of an electric range, one of the first questions asked is "How does it compare in cost," with the fuel which the customer may then be using for cooking purposes. The question of comparative cost is one which should be carefully handled and we do not propose to deal with it here. However, there are so many advantages in connection with the use of electricity for cooking purposes over any and all other kinds of fuel that the question of comparative cost is not of such great importance as it would seem at first glance. Lighting by means of gas has always been considered much cheaper than by means of electricity, but today almost everyone demands electric lighting if it can be obtained, regardless of the expense as compared with other illuminants. The reason of this condition is that electric lighting has advantages all its own. We feel that electric cooking also has advantages all its own, which tend to minimize comparisons regarding relative cost of operation. For the benefit of salesmen and other central station employes the following list of advantages of cooking by electricity has been compiled. It is not claimed that the list is a complete one.

1. **Safe.**—The elimination of matches and the fact that there is no flame which means absolute protection from the hazard of fire. No danger of explosions.

2. **Clean.**—No blackened walls, dirt, soot or smoke. Also electric ranges are easy to clean and easy to keep clean because no dirt is caused by fuel.

3. **Sanitary.**—No poisonous gases to escape and contaminate the atmosphere and the food which is kept in the kitchen or pantry. If a plant or flower is kept in a room where gas is used, it will soon wither. The air which is not good for plant life is not good for human beings.

4. **Regulation.**—The electric stove has perfect regulation. A quarter turn of the switch starts the fire at maximum heat, another quarter turn of the switch gives medium heat, another quarter turn gives low heat. It can be controlled in such a way that there is an even temperature at all times for the many different kinds of food to be cooked.

5. **Certainty.** The absence of uncertainty as to results to be obtained. A poor cook will cook food better on an electric range and a good cook will do her best with electricity.

6. **Economy.**—Economy in food value otherwise wasted by shrinkage and additional nutriment retained in all food cooked; there being no flame, there is no extraction of juices that should remain in the food, these juices being as a rule the best portion and most vital parts of the food.

7. **Cool.**—Concentration of heat where it is needed; no unnecessary heat in kitchen. The electric stove is especially desirable in warm summer months, there being no radiation of heat in the room.

8. **Bright.**—Bright utensils, no dirty, smoky pots or pans to be constantly cleaned.

9. **Perfect.**—The perfection of baking is done by means of the electric oven, all guess work as to temperature being eliminated. The perfection of broiling is the electric broiler, no fumes or gases to contaminate the food which is cooking so close to the heat and no smoke from spattering grease catching fire from a flame.

10. **Saving.**—Saving in shrinkage in food means saving of money. Time is saved in cleaning up the range and cleaning the utensils. Health is saved due to better nutrition of electrically cooked foods and the living and working in a better atmosphere.

11. **Controlled.**—Cooking becomes an exact science. No uncertainty and no failure, the cooking being controlled by regulators and not by guess.

12. **Appetizing.**—Meals are more savory, more digestible and altogether better.

13. **Efficient.**—Efficient and quick in operation. Heat is instantly available and readily regulated.

14. **Conserved heat.**—Oven retains baking temperature long after current is turned off.

15. **Dainty.**—Kitchen clothes no longer a necessity because kitchen duties become light and the work clean.

16. **Progressive.**—Adds dignity to housework and keeps in step with the march of progress.

[To be continued.]

Commission regulation of municipal utilities is presaged in an argument filed with the Railroad Commission of California by the Pacific Light & Power Corporation in its controversy with the City of Pasadena. Pasadena owns an electric lighting plant and is serving electricity in South Pasadena, a separate municipality. The Pacific Light & Power also serves S. Pasadena and has appealed to the state to regulate and obtain a certificate of public convenience and necessity. The question is of wide interest in California, owing to the fact that a number of cities own public utility plants which are serving consumers outside of the city limits. The commission, in view of the general interest excited by this case, has invited any city attorney or public utility corporation attorney in the state, who desires to be heard, to file a brief in this case. If the commission decides that the City of Pasadena is to be classed with private corporations engaged in public utility service when the city undertakes to sell its power or light to consumers outside its limits, then it will be compelled to make its outside rates conform to a standard which the commission deems just in a regulated field.

DISTRIBUTION OF POTENTIAL ABOUT HIGH VOLTAGE LINE INSULATORS.

BY CHESTER T. ALCUTT AND W. K. SKOLFIELD.

(This is an abstract of a thesis prepared by the authors while students in the electrical engineering department of Leland Stanford Jr. University. The abstract was prepared by Professor Harris J. Ryan and includes results communicated by him to the San Francisco Section of the A. I. E. E. at the February meeting.—The Editor.)

Use is made of the exact similarity that exists between the distribution of current in a conducting medium and the electrostatic flux in a non-conducting medium when the form and arrangements of the electrodes are the same throughout. The distribution of potentials that are caused by the current and flux are also similar.

Thus a high voltage line insulator, conductor, pin and the air in which they are immersed may be replaced by a model made up of materials having conductivities that are related to one another, quantitatively, precisely as are the specific inductive capacities of the corresponding real things. In this model, alternating current may be set up from the "pin" through the "insulator" and "air" to the conductor.

As is well known, the potential surfaces thus established in the "air" about the "insulator" may then be located by means of a probing electrode connected through a telephone receiver from a potentiometer that bridges the supply leads and from which any desired fraction of the voltage applied to the "insulator" may be tapped. To locate a potential surface the probe is moved through the "air" about the "insulator" along the corresponding line of silence as located with aid of the telephone receiver.

Expediency requires that a conducting fluid be used for the "air" in the model and that the "insulator" be made of some material that can be readily formed and that can be conductively altered as required. The "pin" and "conductor" in the model must be of high conductivity metal. Such models are easily constructed in all those cases where the insulator proper and its adjacent conductors constitute a solid of revolution. A fairly exact example of this sort is a suspension-strain insulator. A closely approximate example is an ordinary pin-type insulator supporting a transverse conductor; it would be more exact if the conductor were mounted axially with respect to the insulator and pin. In these cases the model needs to be made only of a sector of the original which is much less expensive to make than for the complete insulator. Most of the cases that arise in practice are almost exactly or approximately of the solids of revolution sort for which models of corresponding sectors only have to be made. The insulators studied were those for which models of sectors only were required.

The construction of a model of a sector of an insulator, pin and conductor is shown in Fig. 1. The procedure in making such a model is as follows: About equal parts, by volume, of lampblack and plaster of paris are thoroughly mixed. Water is then added and the mixture is stirred until it becomes a thick paste. This paste is moulded into a 10 to 15 degree wedge. The model of the sector of the insulator is then cut out with a sharp knife, carefully following the edges of a templet prepared in advance. This operation should

be carried on rapidly as it is difficult to cut the composition after it has set. The templet should be constructed of paraffined carboard. If it is allowed to adhere to the composition, the model will be greatly strengthened and there will be less danger of breakage in subsequent handling. If desired, the model may be made in parts corresponding to the shells of the actual insulator, using conducting strips in place of the cement. As the cement between the shells is a decidedly poor conductor it is probable that little is to be gained by using a multipart model of a corresponding multiparted insulator.

After the model has hardened it is placed in a rectangular glass-bottomed tray with its axis parallel to one of the sides. The tray is constructed with a sheet of cross-section paper under the glass to facilitate the location of points on the paths of silence traced by the probe. The "pin," "tie-wire" and "line conductor"

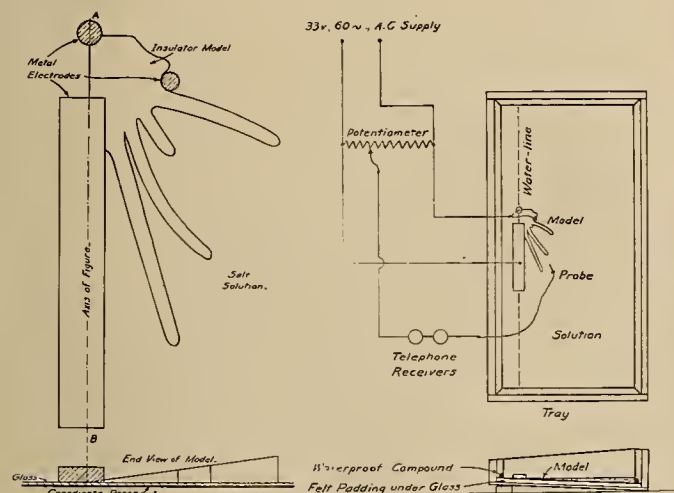


Fig. 1. Model of Insulator in Tray for Testing.

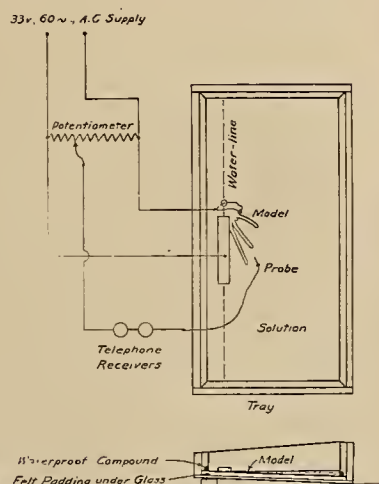


Fig. 2. Diagram of Tray and Electrical Connections

are of metal and are placed as shown in Figs 2, 3a and 3b. To represent the ground in the case of the suspension insulator, a metal plate is mounted in the tray perpendicularly to the axis of the insulator and at the proper distance below it. Such plate is connected to one side of the current source. The model and the metal parts are fastened to the bottom of the trap by means of sealing wax. Suitable connections are made to the pin, line-conductor and tie-wire. Then the tray is tilted until the top surface of the model is horizontal and a salt solution is poured in until it stands level with the top of the model. See Figs. 2 and 3a.

The most satisfactory way to obtain a solution of the proper conductivity is as follows: Out of each batch of plaster of paris-lampblack mixture a flat, rectangular slab about one-quarter of an inch thick is made. This slab is placed in a tray with suitable electrodes as shown in Fig. 4. The electrodes are long rectangular metal bars and are placed parallel so that the distance between them is equal to twice the width of slab. Then the tray is filled with water up to the level of the top surface of the slab. As water dissolves a small amount of plaster of paris (calcium sulphate) it must be saturated with such plaster prior to the use herein so as to prevent any dissolution of the slab and consequent change in the conductivity of the liquid. An alternating electromotive force is applied between the electrodes and salt is added to the water

until the drop in potential across the slab is about one-sixth of the total. This gives a conductivity ratio of 5 to 1, corresponding to a specific inductive capacity of 5 for the dielectric in the insulator. The potentio-



Fig. 3. a. Locating Lines of Silence.



Fig. 3. b. Insulation Model on Plotting Board.

meter method used in measuring the drop is made clear in the diagram.

With a little experience it is possible so to proportion the plaster of paris and lampblack mixture that the saturated solution of the plaster will have nearly the correct conductivity without the addition

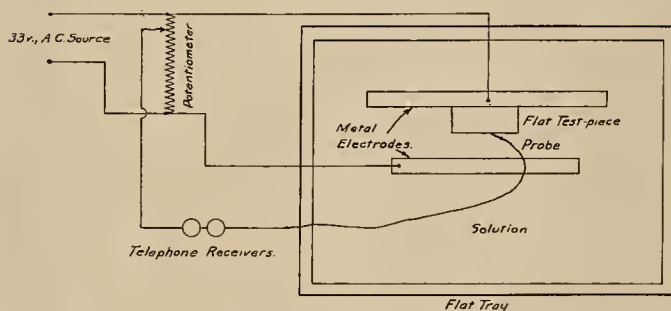


Fig. 4. Arrangement for Solution Conductivity Test.

of salt. The conductivity ratio may vary from 4.5 to 5.5 in., 5.0 is the correct ratio without effecting material distribution about the model.

The electrical connections used in tracing the equipotential surfaces are shown in Fig. 2. A source of alternating current is connected to the electrodes

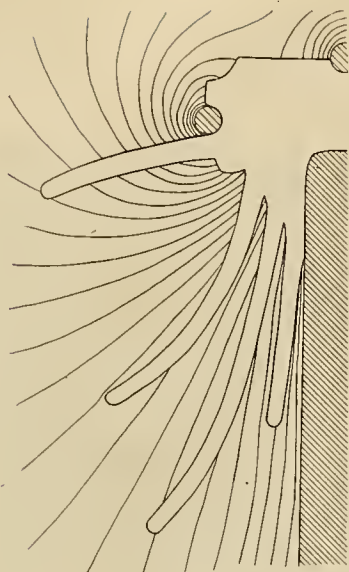


Fig. 5.

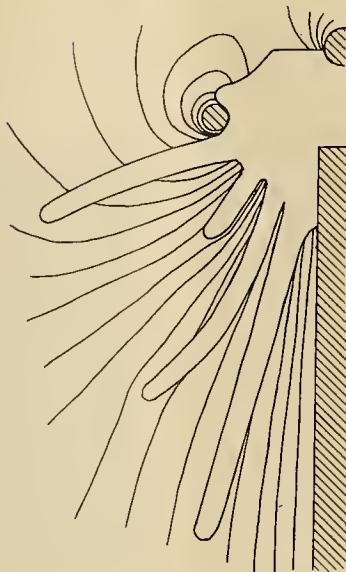


Fig. 6. Dry.

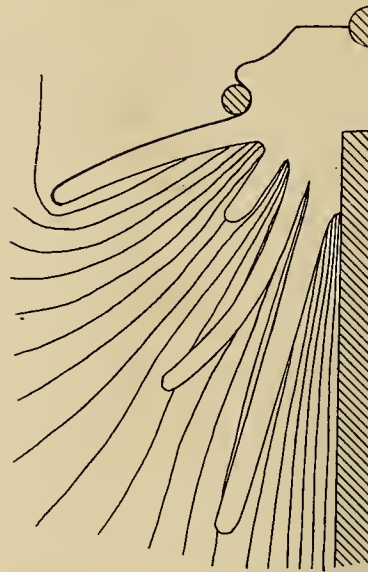


Fig. 7. Top Surface Conductive.

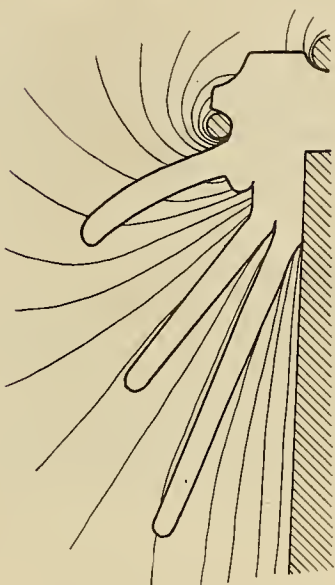


Fig. 8.

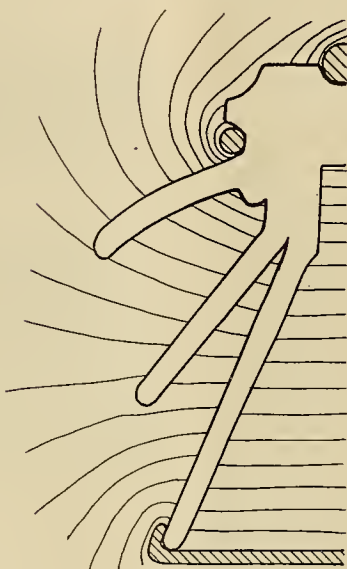


Fig. 9.

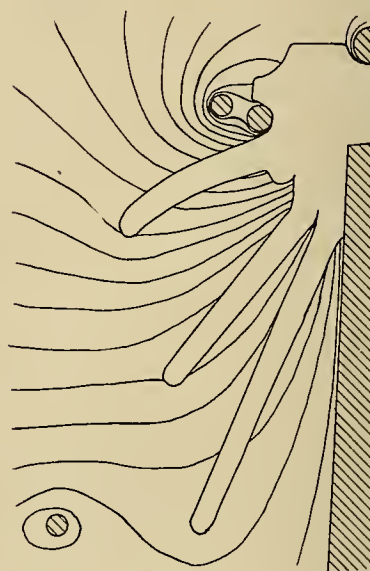


Fig. 10. Showing Effect of Arcing Rings.

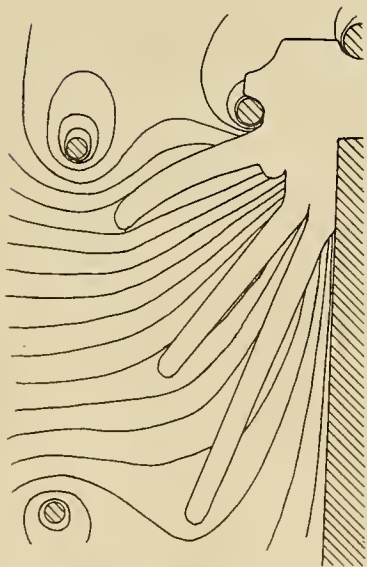


Fig. 11. Showing Effect of Arcing Rings.

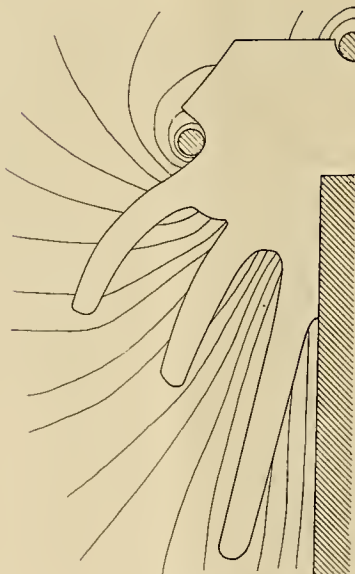


Fig. 13.



Fig. 14. Single Suspension Unit

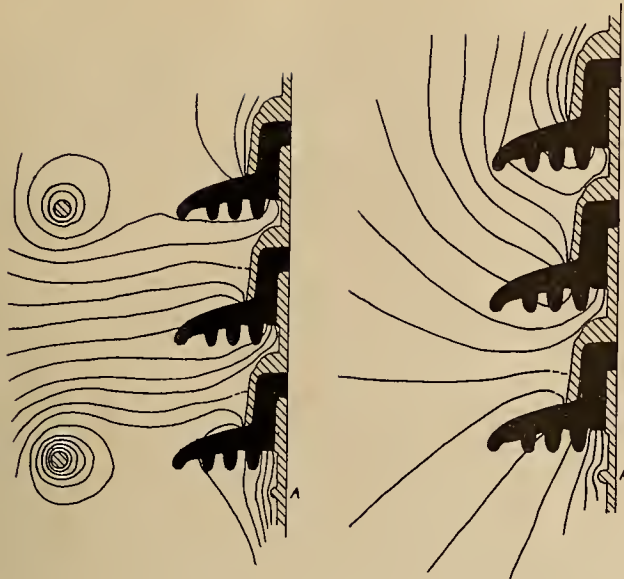


Fig. 15 Three-Unit String, Bottom Pin at Ground Potential; Ground 2 string-lengths below A.

Fig. 16. Three-Unit String with Arcing Rings; Ground 2 string-lengths below A.

representing the pin and line conductor. The probe point consists of a short piece of enamelled wire, the tip of which is bare. The probe is connected through a pair of telephone receivers to the potentiometer, as shown in the diagram. By means of the potentiometer it is possible to divide the voltage across the insulator model into any number of equal intervals. In locating the equipotential surface corresponding to one of the voltage intervals, the probe tip is moved around in the bottom of the tray until a point is found whereat there is no sound in the telephone receivers. The position of the point is read off on the cross-section paper in the bottom of the tray. It is then platted on a similar piece of cross-section paper upon which is a drawing of the insulator section in the same relative position with regard to the coordinate axes as the model in the tray. A sufficient number of points on each equipotential surface are determined and plotted to enable the line locating such surface to be drawn in.

The writers had at their disposal only a sixty-cycle source of current. A higher frequency would have enhanced audibility in the telephone receivers and would have been far preferable. When the work is done in a quiet room the 60 cycle current makes enough sound to locate the null point accurately.

Most engineers visualize the conditions existing in an electrostatic field by a consideration of the flux lines rather than the potential zones. The tubes of flux are everywhere at right angles to the zones of potential, and may, therefore, be sketched in if desired. Since the lines that locate the potential zones mark the voltage duties that are carried by the surfaces of an insulator and by the atmosphere adjacent thereto, it is of corresponding importance to become familiar with the character of such lines. Broken lines locating the electrostatic flux tubes about a link-type insulator are drawn in Fig. 17.

The accompanying diagrams were made by the method described above. The equipotential lines are shown only in the air surrounding the insulator and terminating upon its surface. No attempt was made to locate them within the body of the insulator. They

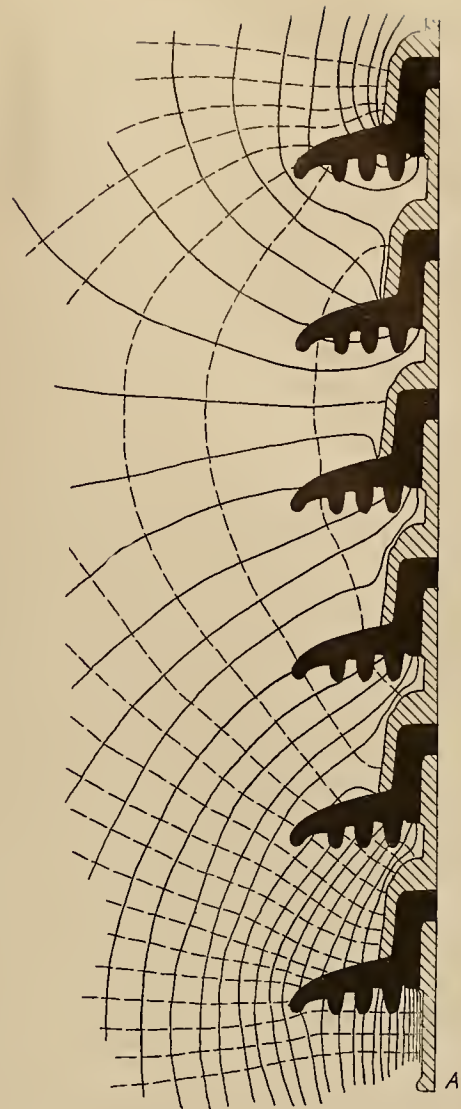


Fig. 17. Six-Unit String; Ground 2 string-lengths below A.

speak for themselves and little needs to be added to enable the reader to study and understand them for himself. They mean much or little according to one's own need and experience with high voltage line insulators. They express for all the voltage duty that the surfaces on an insulator and the atmosphere about it must sustain.

Figs. 5 to 13, inclusive, show the forms of various pin-type insulators, conductor mountings and their corresponding potential zones. Figs. 6 and 7 may be compared to note the change produced by rain that has rendered as yet only the top surface of the insulator conductive. The large change in the potential field produced by the substitution of a conducting base for a conducting pin is seen when Figs. 9 and 10 are compared. Changes in the field produced by the use of arcing rings are seen when Figs. 9, 10 and 11 are compared. A comparative study of Figs. 5 and 13 is of particular interest. Link-type insulator potential fields are found in Figs. 14 to 17 inclusive. The corresponding changes in the fields due to the use of one, three or six units may be seen by comparing Figs. 14, 15 and 17. In the last, as stated earlier, the broken lines locate the tubes of electric force about the insulator. Some idea of the effect upon the potential field about a link insulator due to the use of arcing rings will be obtained by comparing Figs. 15 and 16.

APPREHENSION REGARDING THE NATIONAL ELECTRICAL SAFETY CODE.

BY R. J. McCLELLAND.

(This searching analysis of the shortcomings of the Code prepared by the U. S. Bureau of Standards is slightly condensed from the author's remarks at the Chicago conference on this subject, May 29, 1916. Mr. McClelland is chief engineer for the Electric Bond and Share Company and is an authority on problems attending public regulation of electric distribution lines.—The Editor.)

I am in sympathy with the aim of the Bureau of Standards in preparing this Code, i.e. to eliminate or discourage improper and unsafe construction and to bring about a somewhat greater degree of standardization than at present obtains. This aim, so far as it is realizable, will, I believe, result in great benefit not only to the public but to the electrical industry. I appreciate also the very full and fair opportunity which the Bureau has afforded the electrical utilities of expressing their views and of offering suggestions, although the wish might be expressed that the carefully prepared suggestions of the industry's representatives might have been accorded greater weight.

With the Safety Code in the form now presented, and with the understanding that it is to be urged for adoption as law, I cannot, however, do otherwise than view with grave apprehension its possible and indeed inevitable effects on the future growth of our industry and on the development of the regions which are more or less dependent upon electrical service.

If the Safety Code were to be administered by those who have framed it, the industry would not feel its present apprehensions. It could safely rely on the unwise features being eliminated as their effects became evident. But this Code is not to be administered by the Bureau of Standards, it will not and cannot be administered in the same broad and intelligent spirit in which it is framed. It will be administered mainly by men not in touch with or familiar with the needs of electric service and not in a position to understand the necessity for local modifications. The conclusion is inevitable that if the Code were formally adopted by state or municipal authorities, its administration would generally be inflexible, changes would be exceedingly difficult, even where sanctioned by the Bureau, and the Code would in the main become retroactive. While the Code is in the hands of the Bureau it is a growing thing, capable of any needed development or improvement. Once the Code has gone into the body of local laws, it has passed from the control of the Bureau. It is like a boulder started down a mountain side, once gone, its course and effects can no longer be guided or influenced.

A very unfortunate aspect of the situation, is that the Code contains at present certain features which are so impracticable that it is out of the question for the electrical utilities to observe them. The administrative authorities instead of altering these features would presumably merely allow them to go unenforced. The utilities would thus be forced into the position of breaking the law, a position they are exceedingly anxious to avoid.

The Code in its present form combines a detailed construction specification with a treatise on design. Now it seems to me impossible, and it has seemed impossible to all practical electrical men, to draw a

minutely detailed specifications of national scope. It is inevitable that a detailed specification so drawn as to be adequate and reasonable for one section must be wholly unreasonable for another. If this Safety Code is to evolve into a Code generally fair and satisfactory, the first and most important step must be to strip it of much of its detail and to make it more a code of general results to be attained than of specific measures to be carried out.

The conditions over the country differ far too widely to permit of any generally applicable detailed code. The Safety Code at present covers one only of the points of difference, that of climate, and even this is covered merely by arbitrary boundaries drawn on a map. I may note in passing that this map places Dallas, Texas, in the same classification as regards sleet loading with the Atlantic Seaboard and the region adjoining the Great Lakes. The Safety Code ignores other points of difference between various parts of the country equally as important as those of climate, such as:

- (a) Different standards of service;
- (b) Different operating methods
- (c) Difference in state of development of the region.

It is, or should be, obvious that the same standards and the same construction and operating methods cannot apply fairly both to regions where loads are large, distances are short and industries are well established, and on the other hand to regions where loads are small, distances are long and industries are struggling for a start.

It may be noted also that the Code appears to us to make rigorous provision not only against hazards which are evident and demonstrated, but against hazards which, while conceivable, have not been encountered in practice.

While not agreeing that a National Code can properly be a detailed specification, we have been, and are, desirous of co-operating in assuring that it at least be a reasonable and correct specification. From this viewpoint, there are numerous changes of specific features which should be made before the Code is issued, or at least before it is adopted by State Commissions. These changes are essential if, in some regions at least, actual disaster to the electrical industry and the public which it serves is to be avoided. It is, of course, not possible to enumerate these individual points now.

Many provisions are reasonable as applied to some regions but seriously restrictive as applied to others. Some, and some which are very important, are wholly wrong for any region. For instance, the strength requirements for line construction, taken in connection with the maintenance requirement, are more severe than in any specification I have ever seen issued. The initial strength requirements for lines would rule out a large amount of good modern construction. The combination of strength and maintenance requirements would, and I say it advisedly, not be met by two-thirds of the distribution lines now in service. The tendency to discourage joint construction between different companies and to require several parallel lines where one would serve is directly contrary to public policy. The placing of prohibitive requirements on the construction of light lines serving small loads will

be a public calamity. We have been endeavoring, ourselves and the industry generally, in the relatively undeveloped regions, to assist and accelerate the region's development. We are building lines which, even with the light construction now used are showing considerable deficit. To require that these lines be made more expensive is merely to require that we restrict or cease our efforts toward public development.

Another instance of wholly incorrect requirements is conductor sags. In the light of all of the experience since electric lines have been used, many of the sag requirements are absurd, being frequently double those now in use. Another instance is the prohibition of concentric wiring, probably one of the greatest advances in electrical distribution methods which recent years have produced. There are similar impractical and unwise requirements in other sections of the code.

It has been the hope of most of the electrical utilities that a Safety Code would be produced which the industry could welcome and whose sanction by state or municipal authorities they would not need to fear. This hope seems largely to have been proven vain. Unless important modifications are made in the proposed Code before it is issued, the utilities have no other course open, in justice not merely to themselves but to the present and future users of electrical energy, than at least to put forth every effort to procure radical revisions of certain features. The Code cannot be otherwise than a menace to the public good until these revisions are effected.

GILROY LIGHTING.

On Saturday, June 3, 1916, Gilroy, Cal., enthusiastically celebrated the installation of her new lighting system. The new system, which is the first of its kind on the Pacific Coast, consists of 35 4-ampere General Electric ornamental luminous arc lamps, and four pendant refractor luminous lamps, along the main street and extending onto the state highway. The lamps are the same as proposed and used by W. D'Arcy Ryan at the Panama-Pacific International Exposition and as will be used on Market street, San Francisco. Gilroy has the honor of being the first of California's smaller cities to adopt this very ornamental type of lighting system which is an ornament to the city section of the state highway and a telling advertisement to all visitors of the progressiveness of the city itself. The system has been installed on the standard smaller town lines, namely, staggered units approximately 150 ft. apart. The light is ample at any point on the street, and the system is a tremendous improvement over the old form of series incandescent pendant unit system. One of the particular features of this installation is that the entire system was installed at the expense of and as the property of the Coast Counties Gas & Electric Company, the local central station. The merchants and city were not asked to stand the installation costs, but the city signed a long time contract with the Coast Counties Company to take care of the upkeep, operation and initial investment, it being realized that this is the ideal arrangement for all concerned. The actual work of installing the system was done by the Gilroy Appliance

Company, E. Douglas Hollenbeck, manager, and many compliments have been heard about the excellent work done and the appearance of the poles and lamps.

The Coast Counties Gas & Electric Company is reconstructing the entire lighting system inside Gilroy's city limits to conform to the state law of 1911. Enough reserve capacity in the series rectifier equipment is available to operate 15 more of either the ornamental or pendant refractor luminous lamps, and these will be added when conditions warrant. As soon as automobilists appreciate the big advantage of the present lighting, there will probably be a strong demand for the additional lamps further out on the highway.

COSTS OF ELECTRIC IRRIGATION PUMPING EQUIPMENT.

The following tables giving the capacity and prices of pumps and electric motors are prepared from data secured from various manufacturers and dealers and published in a bulletin on the Rogue River Valley Project as investigated by the U. S. Reclamation Service in co-operation with the State of Oregon. The prices in all cases are for material delivered f.o.b. Portland, being obtained in October, 1915, and representing approximately the net prices:

Cost of Electric Motors.

Three-Phase, Alternating Current, 60-Cycle Motors.

These prices hold for either 220 or 440-volt motors, and include pulley and sliding base.

Brake H.P.	Wgt. lbs.	Rev. per Min.	Price.
2	140	1,800	\$ 57.10
3	180	1,800	64.70
5	340	1,200	105.10
7½	600	1,200	170.00
10	800	1,200	207.00
15	860	1,200	242.90
20	1,250	900	318.75
25	1,590	900	358.85
30	1,500	900	393.85

Single phase motors are from 30 to 60 per cent higher than above prices.

Cost of Electric Motor-Driven, Direct Connected Centrifugal Pump Units.

Three-Phase, Alternating Current, 60-Cycle Induction Motors.

These prices hold for 220 or 440-volt motors.

Pump Size, in.	Capacity, Gal. per Min.	Head Ft. Total.	Pump and Base		Motor		Complete Unit	
			Weight, lbs.	Price.	Weight, lbs.	Price.	Weight, lbs.	Price.
1	25	30	1,730	175	70	43	255	\$113
1½	50	..	1,730	210	85	47	293	132
2	100	..	1,730	225	100	53	370	153
2½	150	..	1,730	400	115	61	555	176
3	225	..	1,730	450	130	61	605	191
3½	300	..	1,730	500	145	70	725	215
4	400	..	1,730	550	160	70	775	230
5	700	..	1,130	800	250	200	1,555	450
6	900	..	1,130	1,000	270	200	1,755	470
7	1,200	..	1,130	1,300	300	235	2,200	535
8	1,600	..	1,300	1,500	350	275	2,625	625

Silicon steel is used in the construction of the cores of static transformers because the hysteresis loss is thereby lowered. Aluminum, phosphorus, nickel and tungsten have a similar effect, but silicon is the cheapest. For low induction its permeability is as great as that of any known iron alloy. The silicon content is usually between 4 and 4¼ per cent. The transformer cores are built up of thin sheets which are separately stamped to shape.

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Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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Intensely interesting as the narrative of an explorer in a strange country is the account of Professor Harris J. Ryan's classic investigations into the field of electrostatic stress surrounding high tension insulators, as published elsewhere in this issue. Hitherto, little has been known of this hinterland of electrical science, inaccessible to commerce until its practical reality has been opened up by his discoveries. But now that the field has been mapped, great benefit is to be gained by the manufacturer and user of high tension insulators and high voltage bushings for oil switches and transformers.

A word of caution is necessary for the guidance of one who would follow the trail that has been blazed by Professor Ryan. The equi-potential lines which have been mapped by his student aides in following the lines of silence are merely the contour lines of the field. The gradient of strains is at right angles to these lines, just as the grades of a terrane are perpendicular to the contour lines of a map. Consequently in order to determine the tendency to puncture an insulation it is necessary to mentally visualize the stress gradients just as a traveller follows a map. The authors have done this in one instance to indicate the method. In this way it is possible to graphically determine the good and bad features of insulator design, and profit from this most commendable research work.

One contractor, when approached on the subject of this editorial, like the farmer who saw a giraffe for the first time, exclaimed "there ain't no such animal." The fact of his statement is more nearly correct than is the grammar. Electrical contracting has a poorer financial rating than almost any line of business. The reasons are many, but all spring from the one taproot of ignorance of business principles.

Primarily the average electrical contractor is an expert workman, and secondarily a business man. That he has been so slow in learning business methods is largely the fault of the firms from whom he buys his supplies. Some electrical jobbers have been so short-sighted as not to recognize that their own success depends upon the success of their customers. This accusation seems harsh, but analysis will demonstrate its truth. Before the electrical business can expect to expand to its proper dimensions the foundation must be more securely laid. The business ability of the electrical contractor is the foundation of the electrical trade. This can be developed only by business instruction from the jobber and manufacturer.

True, there have been spasmodic efforts to teach better cost finding methods to the electrical contractor and dealer. Occasionally some one emphasizes the importance of taking account of the overhead and gives suggestions as to how to minimize it. Helpful hints are often given as to how to improve collections. But all these remedies only scratch the surface. They all ignore the reason most often named as a cause of business failures, or at least in naming it do not recognize its true import.

This fundamental obstacle to business success

is usually called "insufficient capital," which is only another name for insufficient frequency of capital turnover. It is not the amount of capital, but the frequency of turnover that determines profit. There is no cause that contributes more to negative profits, or Irish dividends, than infrequent turnover.

As a whole, there is perhaps no industry where the frequency of turnover is so low as in all branches of the electrical industry. This applies to the public utilities as well as to manufacturers, jobbers and dealers. The public utilities are constantly making extensions requiring new capital and the manufacturers are constantly developing new appliances and apparatus; the jobber and dealer sells a product for which there is little "come-back," excepting lamps and fuses. Electrical devices stay sold, and most business must be new business.

Yet the most common cause for infrequent turnover on the part of the dealer is too frequent overstocking. The jobber is perhaps more at fault here than the dealer, for the jobber at least knows the limitation of demand, whereas the dealer sees only the quantity discount. The dealer's best policy is not to overbuy and, in the long run, the jobber's best policy is not to oversell. Money tied up in a stock which does not move or which moves slowly is manifestly not available for swinging the rest of the business and so there appears to be insufficient capital, whereas actually there is only insufficient fluidity or turnover of capital.

Rapid turnover is the best way to counteract high overhead. Many electrical dealers hesitate to go into the regular retail districts with the consequent high rents. They have a dingy shop on some side street where shoppers seldom go. Yet other specialty shops seek the crowded thoroughfares and profit accordingly. So we venture the assertion that if the electrical dealer would investigate the immediate saleability of his stock as closely as he does its cost and the credit of the purchaser he would find that a high overhead is not necessarily an obstacle to profitable electrical selling.

The Pacific Coast would be the most vulnerable part of the United States in case of war and probably the first to be invaded by any attacking force. An army of one hundred thousand men could be landed with little or no resistance at any one of a dozen points along the coast with less than twenty-four hours' notice to the inhabitants. The comparatively narrow strip between the Cascade-Sierra Nevada ranges and the sea could be quickly occupied and easily held. It contains everything necessary for the sustenance of an army and would be most attractive. The mountain barriers to the east would effectually protect it from recovery by any but the strongest force.

This is not the idle talk of an alarmist or of one who has ought to gain by the sale of munitions. It is merely a citation of obvious facts. The Pacific Coast was the last piece of continental territory to be acquired within the boundary of the United States proper and would be the first to be lost to a foe having an eye to its many natural advantages.

The time has come when we must be ready to repel possible invasion. And the man among all others who should and could take the leading part in this task is the engineer.

The engineer's training in construction, in handling and caring for large bodies of men and in meeting emergencies, eminently qualifies him as a leader in military organization. Modern warfare is largely a matter of applied engineering. Building defensive works, such as trenches, preparing military maps and acquiring military information, digging mines, transporting men and materials, operating field searchlights and electrifying barbed wire entanglements are duties with which engineers are thoroughly familiar. The regular army is lamentably weak in its engineer forces as is likewise the National Guard, there being but one company of the former and none of the latter west of the Rocky Mountains. With all our boasted engineering accomplishments there are not enough engineers of military age and having the requisite physical requirements in the entire country to furnish engineer officers for an army of a million men.

But engineering knowledge constitutes only one-tenth of what a military engineer must know. First he must know how to fight and then how to protect others who are fighting. How few engineers there are who even know the kind and number of men that they would have to gather together in an engineer company.

Fortunately these deficiencies are gradually becoming known. Here and there engineers are banding together to study the situation. In California an organization of an engineer corps is being perfected and the members taking up a two years' systematic course of study of the military art and military engineering under the tutelage of an officer of the regular army. Similar movements are to be launched in Oregon and Washington.

Unfortunately, however, many other engineers are withholding their support from such praiseworthy efforts so that they may see what action will be taken by the national engineering societies. These societies have been so occupied with the task of making an industrial inventory of material for the army and navy, that they have neglected taking up the problem of training the men who may have to use the material.

Under the provisions of the new army bill any civilian engineer can qualify as an engineer officer in the reserve list of the United States Army by passing an examination in military subjects. One purpose of the study course, as already mentioned, is to make it possible for engineers to pass these examinations.

Patriotism is the moving spirit of such engineering preparedness. Nothing but a prevalent policy of watchful waiting now stands in the way of its accomplishment. Meanwhile, until the Federal Government and the national engineering societies decide on some plan of action, it behooves Pacific Coast engineers to act on their own initiative, associate themselves with some one of the study classes, and be prepared for preparedness. Many years ago a learned philosopher wrote "While we stop to think we often miss an opportunity." The opportunity for engineering preparedness is knocking at the door of Pacific Coast engineers.

PERSONALS

Garnett Young, manager Telephone Electric Equipment Company, is at Seattle.

H. A. Bryte, electrical manufacturers' agent at San Francisco, is at the Yosemite Valley.

E. O. Shreve sales engineer with the General Electric Company, at San Francisco, is in the East.

C. C. Hillis, vice-president and general manager of the Electric Appliance Company, is at Los Angeles.

A. E. Peat, treasurer of the San Joaquin Light & Power Company at Fresno, is a recent visitor at San Francisco.

A. O. Austin, expert ceramist with the Ohio Brass Company, is visiting the Pacific Coast, now being at Los Angeles.

E. R. Davis, general manager of the Pacific Light & Power Company of Los Angeles, was a recent visitor at San Francisco.

B. M. Levy, manager of the Santa Rosa Division of the Great Western Power Company, was a recent visitor at San Francisco.

E. H. Priest, Pacific Coast manager of the Eugene Dietzgen Company, has left for a few weeks' vacation in the Yosemite Valley.

S. L. Nickolson, sales manager of the Westinghouse Electric & Manufacturing Company of Pittsburg, was a recent visitor at San Francisco.

A. L. Myers, electrical manufacturers' agent of San Francisco, has returned from an extended business trip throughout the Pacific Northwest.

A. J. Meyers, Pacific Coast manager of the Wagner Electric Manufacturing Company, left for a few weeks' business to the south.

Ira J. Wolf, Pacific Coast agent for the Pittsburg Specialties Company, has returned from a short business trip throughout the San Joaquin Valley.

W. L. Goodwin, vice-president and general sales manager of the Pacific States Electric Company, has returned to San Francisco from Los Angeles.

W. S. Heger has closed the San Francisco offices of the Busch-Sulzer Bros. Diesel Engine Company and is now looking after his private interests.

Will Davis, of the Pacific Research Laboratories of San Francisco, expects to make a trip through the San Joaquin Valley soon in the interests of the laboratories.

H. W. Whiteside, in charge of the munitions plant of the Westinghouse Company at Hartford, Connecticut, spent a few days the latter part of the week at San Francisco.

B. J. Klein, Pacific Coast representative of the Bristol Company of Waterbury, Conn., has returned to San Francisco from an extended business trip throughout the Northwest.

J. C. Manchester, manager of the Interstate Electric Novelty Company, has returned to San Francisco from a business trip throughout the Northwest, having visited Vancouver, Seattle, Portland, Spokane and Tacoma.

H. P. Royer, formerly connected with the Electric Railway & Manufacturers' Supply Company, has recently left that company and has joined the sales forces of the Marchant Adding Machine Company of San Francisco.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, was the speaker of the day and distributed medals to some of the old employees of the company, at a picnic given at Pinehurst June 10th.

C. L. Cory, professor of electrical and mechanical engineering at the University of California, is in the East where he will attend the annual meeting of the Society for the Promotion of Engineering Education and also the 25th re-union of his class at Cornell.

MEETING NOTICES.

The next meeting of the Electrical Supply Jobbers' Association of the Pacific Coast will be held at Del Monte, June 22, 23 and 24th. There will be an open meeting with the manufacturers on Saturday afternoon, June 24th.

Great Western Power Company N. E. L. A. Section.

The June meeting of the San Francisco Bay Section was held June 12th at the Hotel Oakland. A demonstration of high tension phenomena was given by A. S. Lindstrom of the Thorardson Transformer Company. The experiments covered a range of from 2 to 40,000 volts, and from a fraction of an ampere to 1500 amperes. Moving pictures of the laying of the third bay cable, were also shown, together with a paper by John A. Koontz, Jr., "Laying Power Cables Across San Francisco Bay."

Jovian Electric League of Los Angeles.

The spirit of patriotism permeated the atmosphere at the luncheon, Wednesday, June 7th, as plans for participation in the "Preparedness" parade on June 14th were discussed. The enthusiasm shown indicated that the league to a man, was heartily in favor of the policy of "Preparedness." The electrical division of the parade will be under the auspices of the league, and President Henry F. Holland was appointed marshal. John M. Morris is chairman of the arrangement committee. J. Harry Pieper, speaking for the power companies, announced their hearty co-operation and promised that every available man would be in line. A. E. Morphy, just back from the N. E. L. A. convention, in a short talk, gave some amusing side lights on the meeting and Mr. E. P. Smith, a financial expert from Chicago, also gave a short talk. The speaker of the day, Superior Judge Paul J. McCormick, delivered a stirring address on "Sparks at Random on the Subject of Patriotism." He said that the country is seeing a national awakening of the people to the realization of their responsibility as citizens; it is his belief that hyphenated-Americanism does not exist; that it is a hollow theory as no man can serve two masters or countries and the nation demands, and expects the loyalty, fealty and service of all who enjoy the protection of the constitution, laws and liberties of the country. Jas. F. Rogan, local manager of the Edison Storage Battery Company, was chairman of the day.

San Francisco Electrical Development and Jovian League.

With President E. M. Cutting again at the helm and with E. A. Wilcox as chairman of the day, the June 7th League Luncheon developed much enthusiasm for the rejuvenation and other activities under way. The speaker of the day was Mr. Willis Booth of Los Angeles, president of the Hot Point Electric Company and incidentally candidate for U. S. senator from California. His address amply demonstrated his thorough understanding of Pacific Coast needs. He stated that Frederick the Great's famous prophesy that a big country could never be a successful republic had been disproved largely because of electricity's influence. Electricity is likewise binding nations more closely, and it becomes necessary for this country to take a leading part in the world's affairs. He traced the four great epochs in American history,—the making of the republic under Washington, the era of expansion with the Louisiana purchase, the unification of the nation under Lincoln and the freedom from isolation under McKinley. As regards Pacific Coast affairs, he referred to the need for adequate water power legislation and suggested that Jovian leagues get behind the Shields and Myers bills. He spoke of the great industrial development to which the Coast is destined. He called attention to the need for relief in the oil fields, the necessity for a merchant marine and harbor improvements, and detailed facts regarding the Japanese menace, especially as regards the control of Lower California. He urged that the Alaska situation be treated in a business way. After showing the need for preparedness, he closed his address with an inspiring picture of the opportunity to build the highest type of civilization on the Pacific Coast.

SAN FRANCISCO-OAKLAND JOINT REJUVENATION.

Twenty-nine electrical men were initiated into the mysteries of the Jovian Order at a rejuvenation in Trestle Glen, Oakland, on the night of January 10th, under the joint auspices of Tribunes Orrick and Wilcox of San Francisco and Woodward and Hill of Oakland. The novel feature of an outdoor affair with spectacular lighting effects contributed largely to the success of the affair. The ceremonies were held under a great group of trees by the weird light of lanterns and red fire. A flaming forge marked Vulcans work place deep in the forest and a roaring bonfire took off the chill of the night air and formed a gathering place for the exchange of experiences after the serious work of the evening was over.

The excellent rendition of the ritual also added to the effectiveness of the rejuvenation. Mr. Geo. Gray as Pluto, striking particular terror to the hearts of the neophytes. The several parts were taken as follows:

Jupiter, A. E. Drendell	Mars, E. A. Wilcox
Neptune, E. M. Cutting	Hercules, W. C. Wurfel
Vulcan, A. H. Halloran	Apollo, A. E. Rowe
Pluto, Geo. Gray	Mercury, H. E. Bittman

Imps, Frank Mills, Harold Wolff, Wm. Tardiff.

The new members were welcomed and individually introduced by T. E. Collins, past tribune, during the course of an alfresco supper served after the initiation. Some excellent entertainment had been provided and brief addresses were also made by F. H. Legget, E. M. Cutting, H. R. Noack and others.

Everybody present voted it a most successful affair.

The following candidates were rejuvenated:

E. A. Bullis, Federal Sign System (Electric.)
Paul C. Butte, Butte Electric & Engineering Co.
F. W. Buzzell, Buzzell Electric Works.
Carl C. Caven, Western Electric Co.
Frank B. Ellis, Ellis Elec. & Cons. Co.
Robert R. Ebel, California-Oregon Power Co.
Lee E. Gilpen, Piedmont Electric Co.
R. M. Gilson, Pacific States Electric Co., Oakland.
I. K. Gutfield, Electric Appliance Co.
W. P. L'Hommedien, Westinghouse Elec. & Mfg. Co.
R. D. Kyser, Great Western Power Co.
C. B. Kenney, Ne Page, McKenny Co.
A. S. Lindstrom, Thordarson Transformer Co.
C. W. Malone, California-Oregon Power Co.
J. C. Manchester, Interstate Elec. Novelty Co.
W. C. Martinez, Western Electric Co.
C. J. Newbery, F. E. Newbery Co.
R. B. Peterson, Telephone-Electric Equipment Co.
W. C. Sage, General Electric Co.
T. W. Simpson, Federal Sign System (Electric.)
J. T. Stewart, Electric Railway & Mfrs. Supply Co.
E. B. Strong, Jr., Journal of Electricity, Power and Gas.
M. H. Seid, Ichelheimer Bros. Co.
Edgar Sproul, United Electric & Gas Co.
H. C. Stoddard, California-Oregon Power Co.
C. H. Thane, Pierson, Roeding & Co.
P. W. Todt, Western Electric Co.
Don Trego, Trego, Electric Co.
Kurt Wolff, Interstate Electric Novelty Co.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The railroad commission has authorized the Santa Barbara Gas & Electric Company to issue \$1,000,000 face value 5 per cent first mortgage bonds, at not less than 91, under a deed of trust to the Los Angeles Trust & Savings Bank. Of the bonds, \$210,000 will mature serially at the rate of \$10,000 a year, from 1920 to 1940. From the proceeds of sale \$884,625 is to be used to retire company's outstanding issue of \$824,500 of bonds at 105, and \$25,375 to reimburse company for expenditure made from income.

The Central California Gas Company, which serves gas at Visalia, Tulare, Exeter, Lindsay, Strathmore and Porterville, has applied to the commission for authority to issue \$19,000 face value first mortgage 6 per cent sinking fund gold bonds, to deliver \$12,000 worth to the Los Angeles Trust and Savings Bank, trustee, to meet sinking fund obligations, to sell \$7000 bonds at 90 per cent, to issue \$67,000 6 per cent cumulative preferred stock to be sold for not less than 80, and to issue \$21,500 common capital stock at par.

NEWS OF IDAHO PUBLIC SERVICE COMMISSION.

After due investigation the commission has dismissed the complaint of Local Union No. 291, I. B. E. W. that the Electric Investment Company has violated the commission's rules for certain work at Boise.

NEWS OF ARIZONA CORPORATION COMMISSION.

With regard to the informal complaint brought by C. R. Osburn on behalf of the Board of Control of Arizona, alleging that the maximum electric lighting demand of the capitol building and of the state asylum for the insane as fixed by the Pacific Gas & Electric Company, is excessive, the commission ordered that hereafter bills be based on a maximum demand as shown by tests.

The Mountain States Telephone & Telegraph Company and Prescott Gas & Electric Company have been notified to apply to and secure permission from the commission to transfer pole lines now jointly owned, before said transfer shall be consummated.

To correct discriminatory rates and to permit the Mountain States Telephone & Telegraph Company to earn a fair rate of return the commission has approved the company's standard Class "A" rates for Tucson upon the completion of structural work now in progress.

The Globe Light & Power Company has been given authority to purchase and install additional equipment at a cost of \$12,354 as follows:

Nordberg Mfg. Co., Milwaukee, Wis.:	
15 by 24 Uniflow Engine; contract.....	\$3,950.00
Estimate to put in engine.....	615.00
General Electric Co.:	
150 kw. Generator, 200 r.p.m.; contract.....	1,957.00
Estimated to put in generator.....	239.00
Fred M. Prescott:	
Condenser and condenser pumps.....	1,500.00
Estimated put in condenser.....	120.00
Cooling tower	600.00
Foundation for generator, engine and condenser..	500.00
Extension of building	1,000.00
Piping and labor	500.00
Oil separator and steam traps.....	250.00
	<hr/>
	\$11,231.00
Ten per cent contingent	1,123.00
	<hr/>
	\$12,354.00

The application of the Tucson Gas, Electric Light & Power Company for an order authorizing the deferring of the 1916 depreciation charges, or an order exempting the company from setting aside any depreciation reserve prior to January 1, 1917, has been denied.

TRADE NOTES.

NePage, McKenny Company, Portland, have been awarded a contract to install all the electric lighting features for the Columbia Beach Amusement Company, which is spending about \$30,000 in erecting a modern amusement resort at Columbia Beach, on the Columbia River, near Portland.

The Reliable Electric Company has received the wiring contract for the San Francisco Dairy Company at No. 1553 Turk street, San Francisco.

The Electric Novelty Sign Company of 165 Eddy street, San Francisco, has taken a contract for an electric spelling flasher with letters 14 ft. high to read "Folger's Golden Gate Coffee," erected on this firm's roof facing San Francisco Bay.

Crocker-Wheeler Company have removed their San Francisco salesrooms from 618 Mission street to 87 New Montgomery street, a ground floor location where a large stock of motors can be displayed to good advantage. A large stock is to be carried for the convenience of local buyers.

John A. Turner, city clerk, Prince George, B. C., will receive tenders up to noon, July 8th, for power plant equipment. Specifications and forms of tender may be had at the office of the consulting engineers, DuCane, Dutcher & Company, Rogers Building, Vancouver, B. C., or at the office of the city clerk, Prince George.

The Northwestern Electric Company of Portland has closed one of the largest orders for electric ranges yet reported in the Northwest, in a commission to install 54 "Hughes" ranges in the new Imperial Arms Apartment, under construction for R. F. Wassell. Mr. Wassell also installed Hughes ranges throughout in his Tudor Arms apartment building last year and the results were so satisfactory that he determined on the same equipment for his newest apartment.



NEWS NOTES



FINANCIAL.

SAN FRANCISCO, CAL.—The Mt. Whitney Power & Electric Company of Visalia has been purchased from John Hays Hammond of New York City by H. E. Huntington, president of the Pacific Light & Power Corporation of Los Angeles, whose Big Creek transmission line runs through the Mt. Whitney territory. The two systems will be tied together.

ILLUMINATION.

POMEROY, WASH.—A movement is on foot for the installation of cluster lights on Main street, which would cost about \$1800.

HAYWARD, CAL.—The Pacific Gas & Electric Company is arranging to extend its gas main to San Lorenzo via Laurel avenue and Cherry station.

LOS ANGELES, CAL.—The city council has ordered proceedings started for the ornamental lighting of Washington street from Main to Vermont.

BLYTHE, CAL.—It is stated that the establishment of an electric lighting plant is being considered in Blythe as soon as the town is incorporated.

CLAREMONT, CAL.—The Southern California Edison Company has been granted a franchise to lay and operate a gas distributing system in this city.

RIDDLE, ORE.—Formal acceptance of the franchise for establishing in Riddle an electric light and power business has been filed with the city recorder by A. E. Brais, and actual construction work will begin shortly.

SANTA MONICA, CAL.—The city commissioners have instructed the city attorney to draft an ordinance calling an election to submit to the voters a proposition of a bond issue of \$350,000 to construct or acquire a municipal gas plant.

TULARE, CAL.—Circular letters and maps outlining a plan for the installation of an electrolier system in Tulare are being sent to property owners in the business district and it is expected the system will be installed in the near future.

LOS ANGELES, CAL.—Petitions for improved lighting of Monte Vista Park have been presented to the board of supervisors and the clerk has been directed to notify the petitioner that the only method of securing lights is by the formation of a lighting district.

HOLLYWOOD, CAL.—Actual work on the construction of a municipal lighting system and distributing system for aqueduct power will begin by July 15th. The city council will advertise for bids about November 1st for lighting that section of the city that cannot be covered by the municipal system.

SAUSALITO, CAL.—The town trustees have awarded a franchise to supply gas, to J. A. Fish, representing local capitalists interested in incorporating a Sausalito gas company. The franchise provides that work on the plant must begin within 90 days and that the rate to be charged shall never be higher than \$1.10 per 1000 cubic feet.

BERKELEY, CAL.—The following bids were received by the Regents of the University of California for furnishing and installing lighting fixtures in the library building on the campus, propositions A and B respectively:

E. A. Mantell	\$22,704	\$17,546
Thos. A. Day Co.	17,446	11,653
Ickelheimer Bros.	23,000	14,200
Maxwell Hardware Co.	24,400	14,350
Bradshaw Electric Company	26,963	16,900
Spott Bros.	29,933	15,181
Leo. J. Meybery	23,800	15,900
Roberts Manufacturing Company	21,323	14,941

TRANSMISSION.

BAKER CITY, ORE.—A line has been surveyed by the Idaho-Oregon Power Company for the transmission of electric power to the Iron Dyke and Homestead mines at Homestead, and construction work will start immediately.

SPOKANE, WASH.—Wm. Shannon, manager of the Four Timbers Mining Company in the Coeur d'Alene has closed a contract with the Washington Water Power Company for the extension of the power line to the mine.

TACOMA, WASH.—The board of commissioners of Pierce county has set June 23 as the date for hearing the application of the Puget Sound Traction, Light & Power Company for a franchise to construct a power line over the public roads of the county.

TACOMA, WASH.—Application has been made to the county commissioners by the Tacoma Railway & Power Company for a franchise to erect a power line along Lincoln avenue on the tide flats. The commissioners will give the franchise if the wires do not conflict with telephone wires.

LOS ANGELES, CAL.—The city council has instructed the city attorney to start proceedings to acquire by condemnation a right of way over certain property for the purpose of constructing a power transmission line, together with telephone lines from a point in Inyo county to a point in Los Angeles county.

SAN FRANCISCO, CAL.—Three towers of the San Francisco & Sierra Power Company near South San Francisco were blown up by miscreants with dynamite on the morning of June 11th. No interruption to the United Railroads service was experienced, as the auxiliary steam plant was immediately started. Company officials are at a loss to explain the motive of the deed.

TRANSPORTATION.

OAKLAND, CAL.—The San Francisco and Oakland Traction Company is laying tracks on Grand avenue to connect the Grand avenue line with the Key Route track now ending at Broadway under the Key Route Hotel.

SANTA ANA, CAL.—The Pacific Electric and the city trustees have reached an agreement, by which the Railway Company will get the two franchises which it has been seeking. The company will build a curve at the northwest corner of Fourth and Main streets, a switch off North Main street on to the Southern Pacific tracks at Santa Clara avenue, pave strip on East Fourth street east of the Santa Fe, put tracks into good shape, and put heavier rails on the streets, some of them immediately and others later on.

PORTERVILLE, CAL.—With the visit of officials of the Southern Pacific Railroad, together with Traffic Manager Pontius of the Pacific Electric Company, it became known that the new extensions of the Porterville Northeastern will be operated electrically. It has become known that the extensions to be constructed south from Adobe station to the newly-opened orchards in the Deer Creek district, will be constructed by the Pacific Electric Company, and will be later leased to the Southern Pacific for operation.

TELEPHONE AND TELEGRAPH.

GILROY, CAL.—Bids for the new telephone building to cost \$7,000 have been advertised for.

BURLINGAME, CAL.—Plans for a new central telephone station to be built near Floribunda avenue have been completed.

EL PASO, TEX.—A radio station is to be constructed at Fort Bliss for communication with all the border signal service camps.

IRRIGATION.

SACRAMENTO, CAL.—The Carmichael Colony Irrigation District will vote June 24 on a bond issue of \$90,000 for a pumping plant on the American River, ditches, pipes, etc.

NORTH YAKIMA, WASH.—Reclamation Service engineers have established camp at intake of Mabton syphon feeder canal and are making final surveys for irrigation works for watering 4000 acres. Construction work starts within 30 days.

SALINAS, CAL.—A bond issue to finance a reclamation district from South Lake to Heinz Lake, thence to Mud Lake through Carr's Lake and down the ditch to Tembladera, a total distance of 17.7 miles, is contemplated. Lateral canals to cost \$15,000, and a main canal to cost \$50,000, are proposed.

ANDERSON, CAL.—The directors of the Anderson-Cottonwood Irrigation district have rejected all bids for main gates, side gates and drops. Two bids on the Churn Creek siphon were considered, but neither was accepted. One bid is for \$38,000, the other for \$37,500. No action was taken on bids for the dam. The lowest bid is \$46,000. To date contracts have been let aggregating \$236,000.

LAFAYETTE, CAL.—Preliminary steps have been taken looking toward the formation of a Wright irrigation district of 35,000 acres and including the present Woodbridge irrigation system. It is planned to bond the district for \$300,000, the bonds to run 40 years. The territory is located west of Lodi and south of Woodbridge. It is proposed to construct a storage dam in the foothills east of Lockeford. Over 22,000 acres have already been signed up.

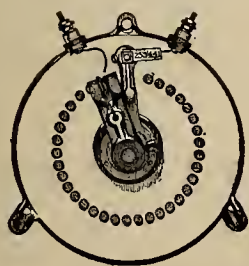
VISALIA, CAL.—Legal representatives of more than a score of irrigation companies have filed formal protests in the courts against the proposal of the Lindsay-Strathmore Irrigation District officials to drive a series of deep wells along the banks of the Kaweah and St. Johns rivers for the purpose of developing water sufficient to irrigate 15,000 acres

of citrus land south of Exeter. The protest is also filed against R. E. Hyde, owner of the property on which it is proposed to sink the wells. The irrigation district officials declare there is no connection between the wells and the amount of flood water.

NORTH YAKIMA, WASH.—Orders to immediately prepare final plans and specifications for the construction of a diversion dam across the Yakima River at the intake of the Wapato canal and the reconstruction of the present distributing system and an extension of this system to cover the 120,000 acres included in the Wapato project on the Yakima Indian reservation have been received by L. M. Holt, superintendent of irrigation, from the Indian office at Washington.

OAKDALE, CAL.—The irrigation board has accepted the Cape Horn tunnel built by James Willison and allowed him the final estimates on the contract, which totaled \$60,263. The board has also ordered the extension of the Campbell lateral, near the Lone Tree section, to supply water to the Steltzner, Campbell and other lands, a total of about 800 acres. The board voted to install a pipe line to provide water for land owned by Bellefontaine Bros., Rodden Bros. and Schadlich & Endicott. About 1650 ft. will be needed and the cost is estimated at \$1200.

SAN FRANCISCO, CAL.—Applications for permission to appropriate water have been filed with the State Water Commission by A. D. Schindler of San Francisco who has applied for permission to appropriate 2000 second feet of the waters of the South Fork of the Kings River, 2000 second feet of the main Kern River and 1000 second feet of the Tule and Kaweah rivers, a total of 5000 second feet, for the Tulare irrigation district. E. H. Dodge of San Francisco makes application, as the forerunner of a corporation which he says is to be organized, for the purpose of appropriating 500 cubic feet per second of the waters of Lee Vining creek, in Mono county, for the irrigation of desert lands.



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E-6	Electric Novelty Works..... 533 Mission St., San Francisco.	S-1	Schaw-Batcher Company, Pipe Works, The..... 211 J St., Sacramento; 356 Market St., San Francisco.
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I-3	Interstate Electric Novelty Co..... 111 New Montgomery St., San Francisco.	W-8	Western Pipe & Steel Co..... 444 Market St., San Francisco; 1758 North Broadway, Los Angeles.
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M-4	Morse Chain Company..... Monadnock Bldg., San Francisco.		

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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VOL. XXXVI NO. 26

SAN FRANCISCO, JUNE 24, 1916

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PROGRESS ON SAN FRANSQUITO POWER PLANT
OF LOS ANGELES AQUEDUCT.

OUT OF DOOR HYDROELECTRIC PLANTS.
BY RALPH BENNETT.

PROSPECTIVE MARKET FOR IRRIGATION
PUMPING.
BY JOSEPH JACOBS.

REPORT OF N. E. L. A. ELECTRIC RANGE
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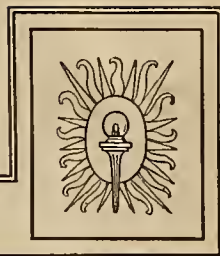
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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy



VOLUME XXXVI

SAN FRANCISCO, JUNE 24, 1916

NUMBER 26

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PROGRESS ON SAN FRANSQUITO PLANT

LOS ANGELES AQUEDUCT POWER PROJECT

The first hydroelectric generating station in an ultimate development of 200,000 h.p. along the line of the Los Angeles aqueduct, is almost ready for operation. Situated near the head of San Fransquito Canyon, 47 miles from Los Angeles, Plant No. 1 utilizes water brought from the Owens River through 200 miles of aqueduct. Only a few finishing touches are necessary to materialize this dream of a decade to an actual reality.

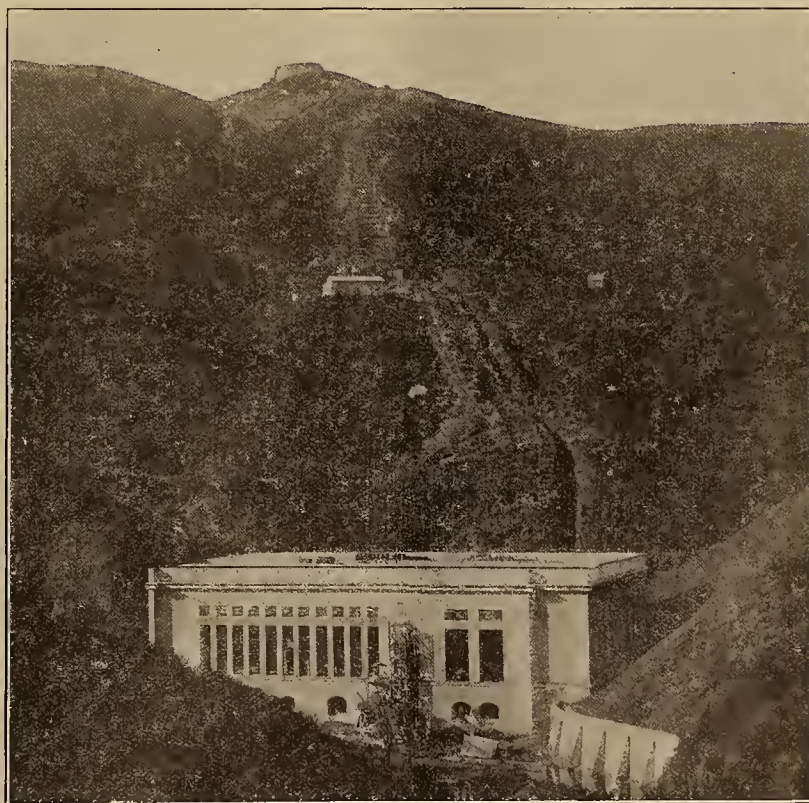
Electric power is a by-product of the great aqueduct which has been supplying Los Angeles and vicinity with water for domestic and irrigation purposes during the past two years. In the 200 miles between the intake and Fairmont Reservoir is a difference in elevation of 3800 feet. This is sufficient not only to provide ample grade to allow of rapid flow of water, but also to allow its utilization for power purposes at several sites.

The most favorable of these and the first to be developed on a large scale is at the outlet of 26,500 ft. of tunnels leading from Fairmont Reservoir to the head of the San Fransquito Canyon. Here an effective head of 870 ft. has been utilized for an initial installation of 22,500 kw. in three generating units. This plant can be doubled in capacity by the installation of three similar units. However, in the judgment of the consulting board of engineers, consisting of W. F. Durand, O. H. Ensign and Harris J.

Ryan, it was thought best to provide three units at the start and add the others as demand warranted. Their first report, submitted on February 12, 1910, outlined the plans which have since been followed under the immediate direction of E. F. Scattergood, chief electrical engineer, William Mulholland, chief engineer for the aqueduct, having supervision of the hydraulic features of the work.

The long interval that has elapsed since the determination to use aqueduct water for power generation and the completion of the project has been due primarily to lack of available funds. Several times work was suspended until bonds could be voted and their validity established. There was one period especially, from January 1914 until July 1915, during which no work could be prosecuted because of the enforced delay.

This power development may be said to begin at the Fairmont Reservoir, which acts not only

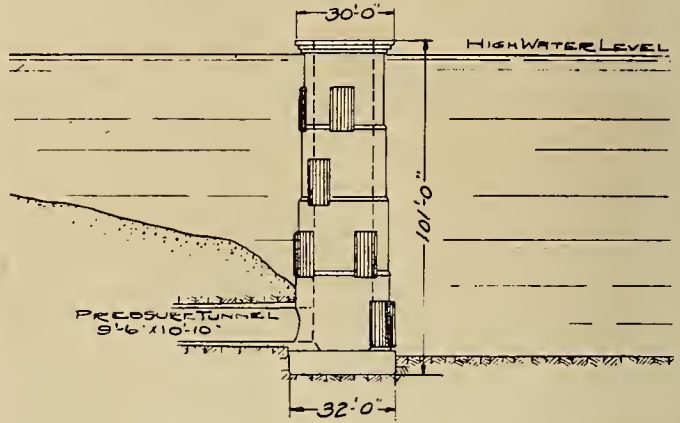
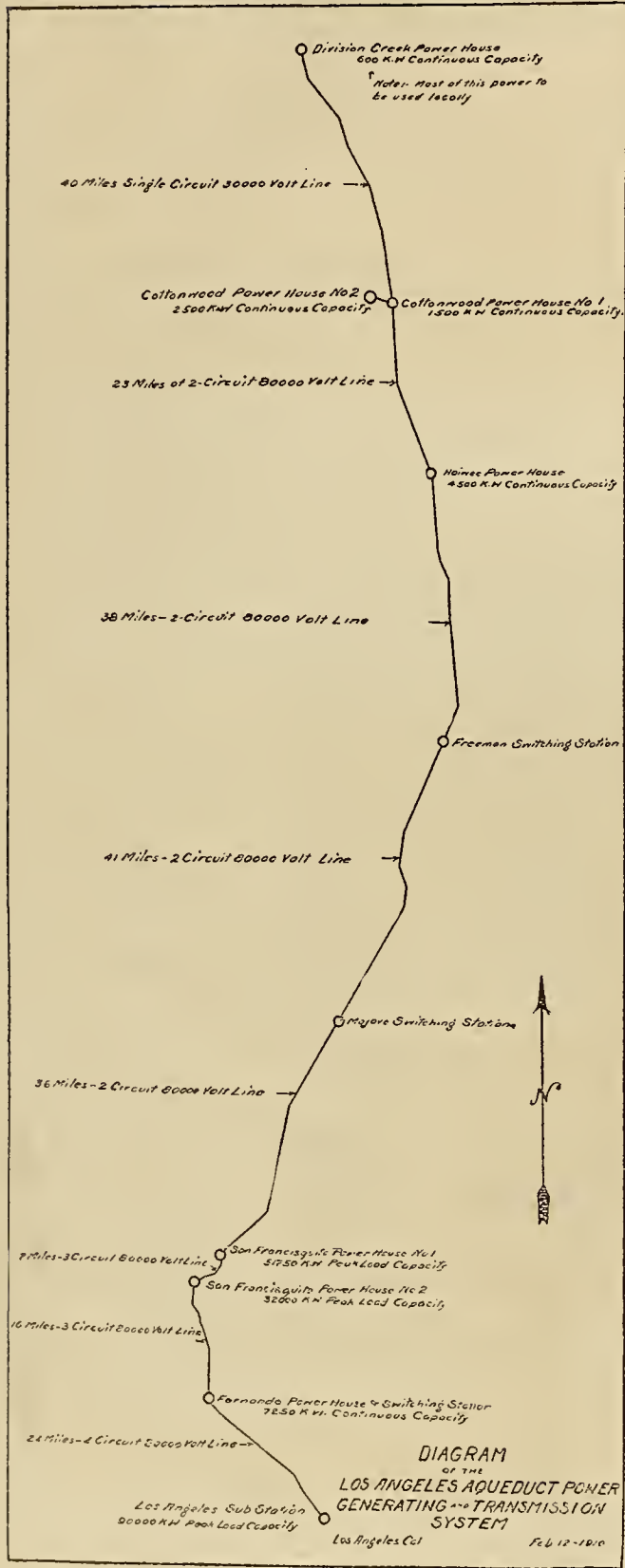


San Fransquito No. 1 Power Plant, showing Penstocks and Surge Chamber.

as one of a series of storages for the water supply but also as power plant forebay, regulating the fluctuations of water to meet peak load conditions at the plant. This forebay has a storage capacity of 7620 acre ft. The conduit leading into the reservoir has a capacity of 20 sec. ft., while the outlet tunnel can carry 1000 sec. ft. to care for peak load demands, the mean discharge being 400 sec. ft. Water is discharged from the lake into the north end of Elizabeth Tunnel through an



Fairmont Reservoir.

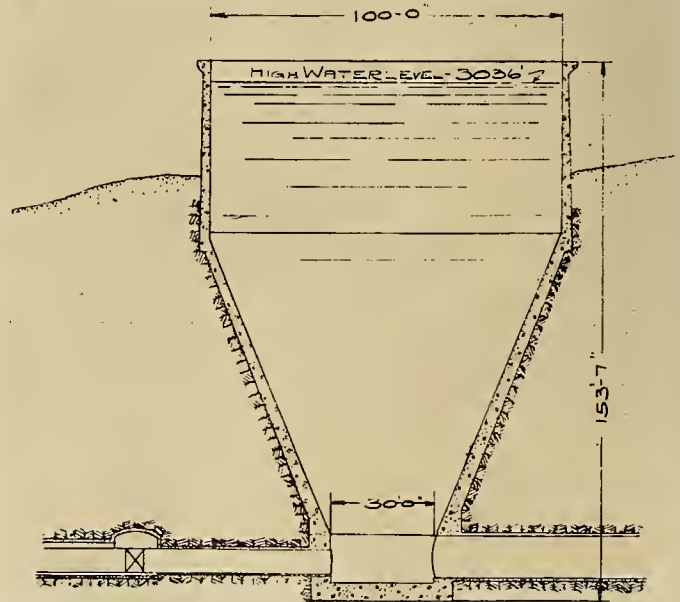


Intake Tower, Fairmont Reservoir.

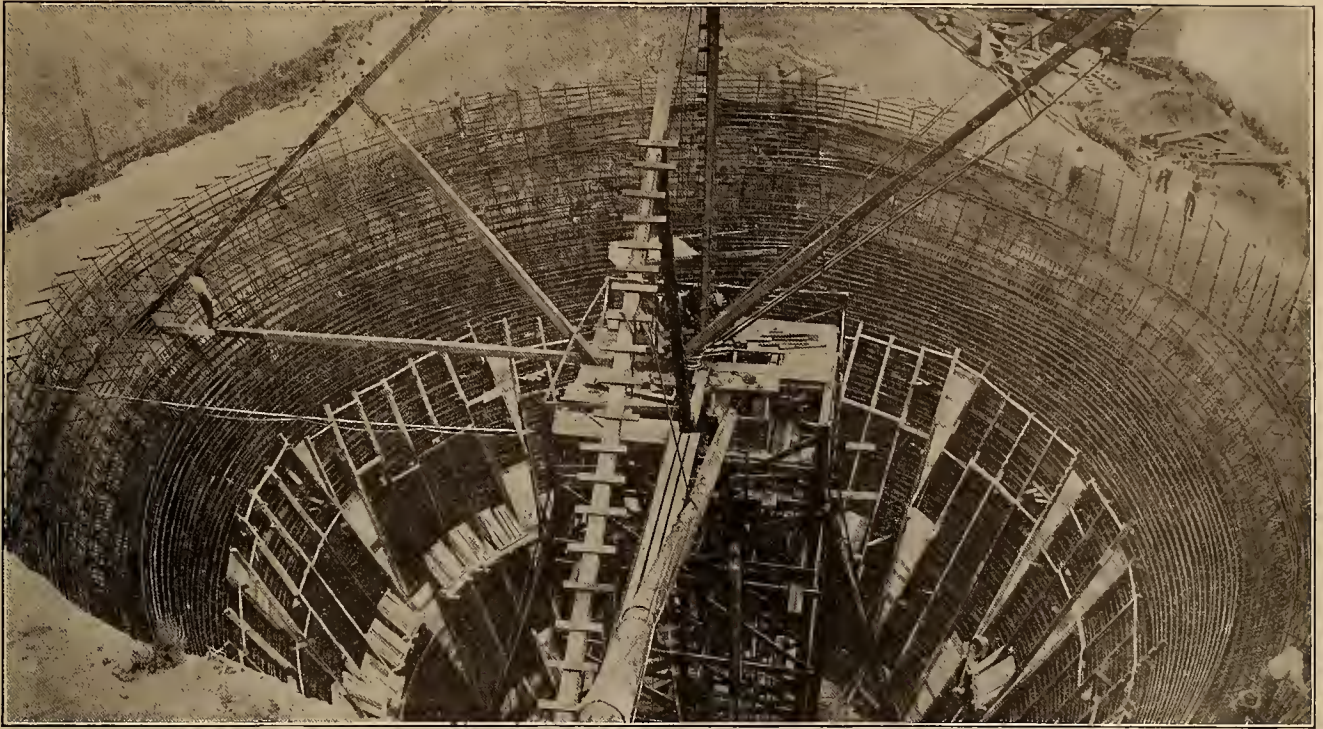
outlet tower and regulating gates, which can be seen in the accompanying illustration. The Elizabeth tunnel, in its 26,500 ft. length, drops 59 ft., and being lined throughout with concrete and being operated under pressure, acts as penstock.

At the south end of the tunnel and at the head of the pipe penstocks is a great surge chamber designed to prevent possible water hammer, pressure waves or sudden changes of head. This has been excavated in the mountain above the tunnel exit and has been lined with concrete so as to be watertight.

The penstock consists of two 7 ft. steel pipes dropping down the mountain side to the power plant. These are approximately 3600 ft. in length from the bottom of the surge chamber to the wheels of the



Sectional View of Surge Chamber.

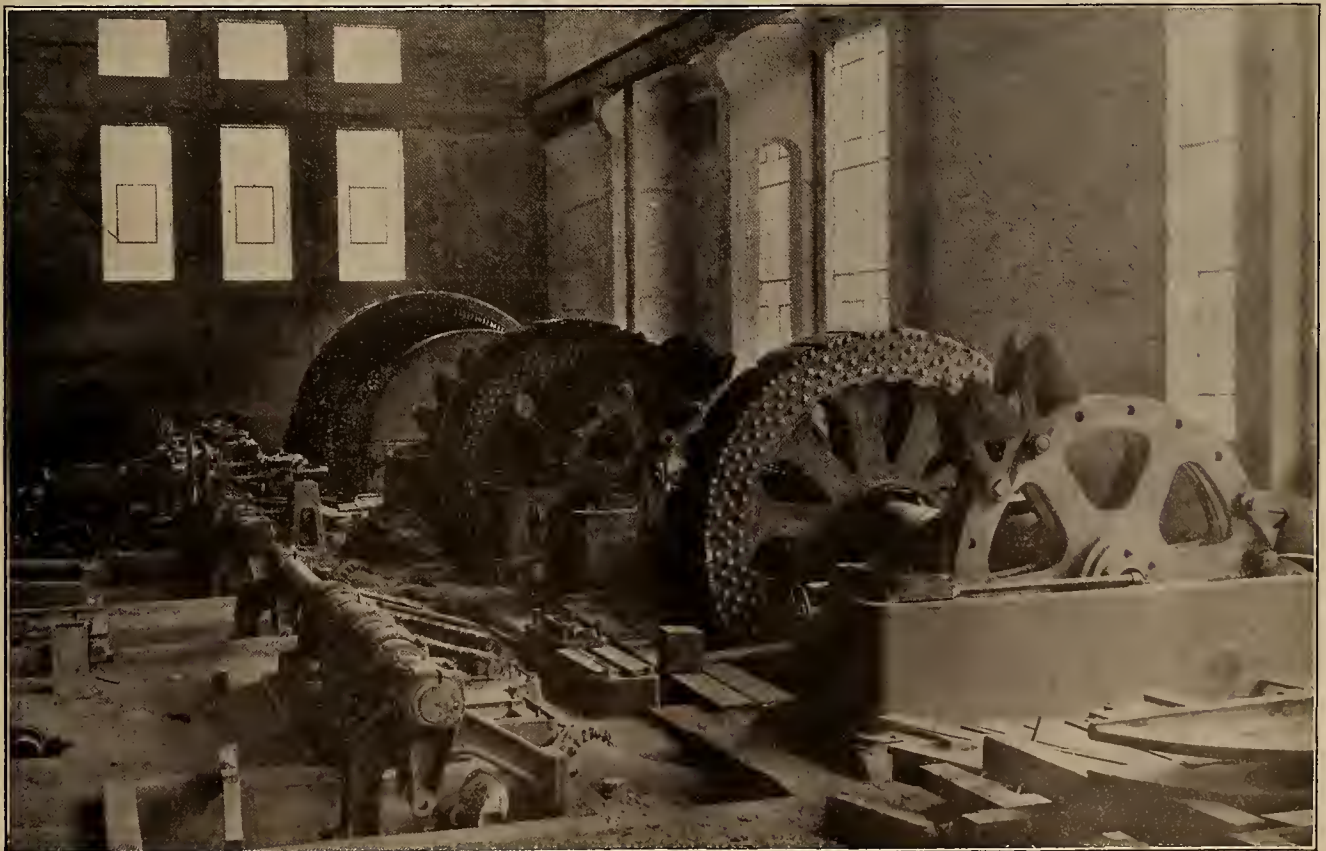


Surge Chamber Under Construction.

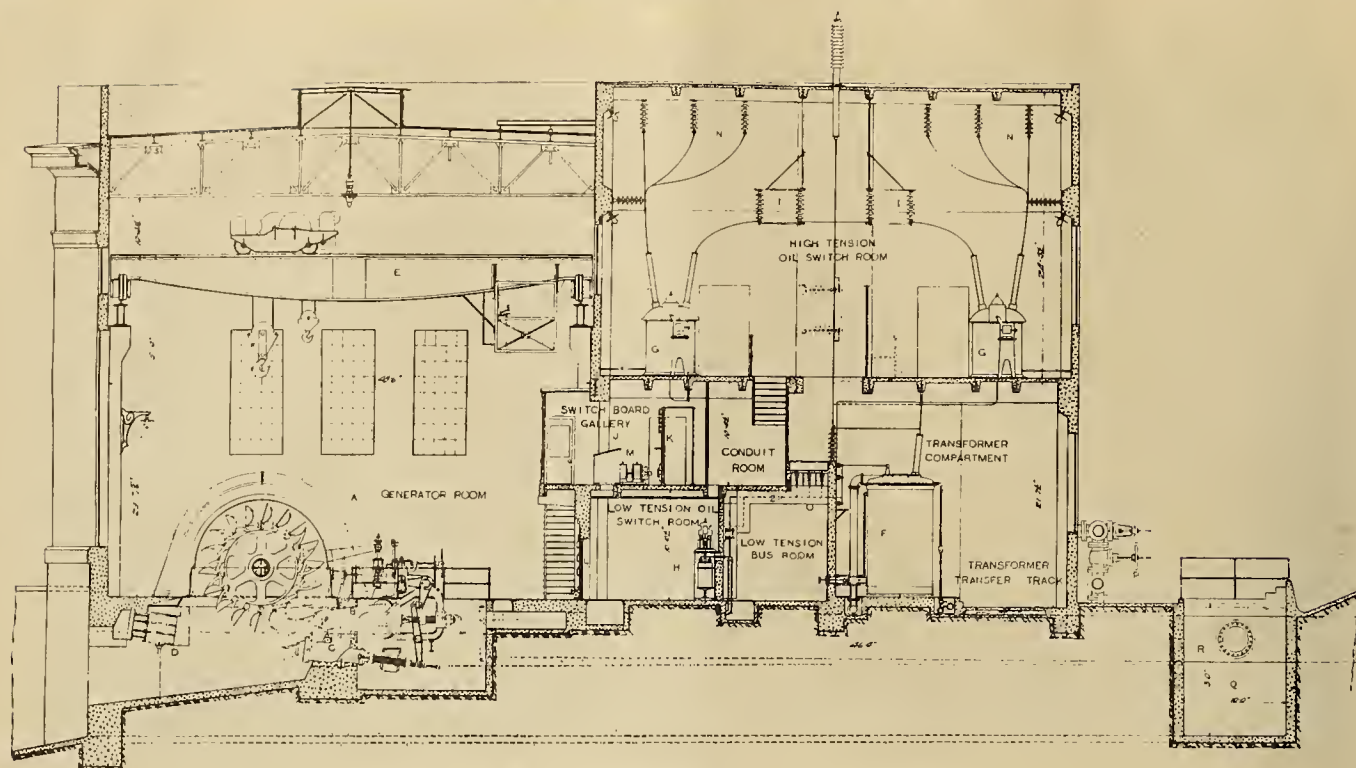
power house. They are designed for a maximum flow of 1000 sec. ft. and, consequently, the head on the penstock at the surge chamber will vary between 10 ft. and 138 ft. and the head on the power house will vary between 800 ft. and 940 ft. as the water flow varies from 1000 sec. ft. to zero. Ultimately there will be 3 penstocks leading from the surge chamber, each of which will branch into two penstocks at a point

in the grade, from which point there will be six penstocks leading to the power house and connecting to 6 separate generator units.

The power house is a reinforced concrete structure, arranged so that its size can be doubled when necessary. It contains 3 generating units, each consisting of a 9375 k.v.a., 6600 volt, 3-phase, 50 cycle, generator driven by double overhung impulse water



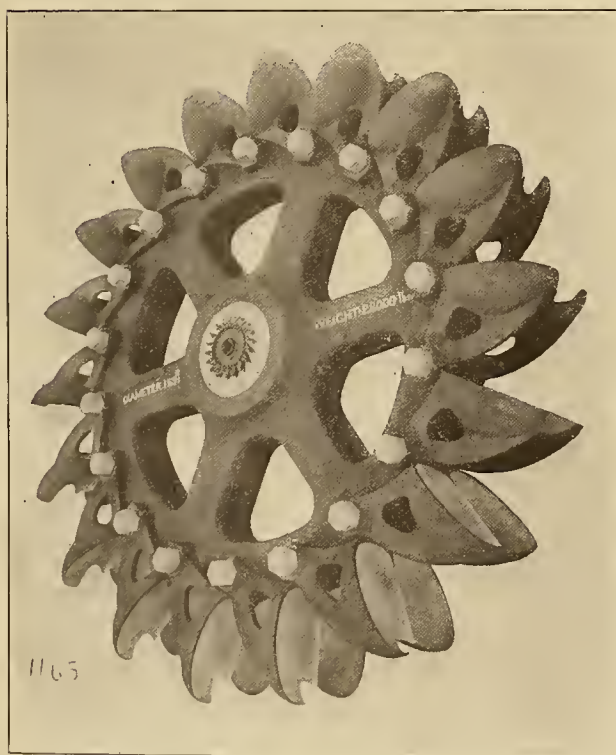
Generating Apparatus as Installed May 29, 1916.



Typical Cross Section of San Fransquito Power House No. 1.

- A. 9375 k.v.a. Water Wheel Generator Unit.
- B. Main Nozzle.
- C. Safety and By-Pass Nozzle.
- D. Vortex Baffle.
- E. 50-Ton Crane.
- F. 3150 k.v.a. 110,000 Volt Transformer.
- G. 110,000 Volt Oil Switch.
- H. 6600 Volt Oil Switch.
- I. 110,000 Volt Disconnecting Switch.

- J. Control Desk.
- K. Meter Panel.
- L. Exciter Switch Board.
- M. Motor Generator Set.
- N. 110,000 Volt Bus.
- O. 6600 Volt Tie Bus.
- P. Exciter Penstocks.
- Q. Discharge Pit Rod Safety and By-Pass Valves.
- R. Welded Penstock.



Waterwheel Runner, Chain Type Construction.

wheels at 200 r.p.m. The generators were furnished by the Westinghouse Electric & Manufacturing Company.

Exciting current is furnished by two 250 kw., 250 volt d.c. generators driven at 400 r.p.m. by single over-

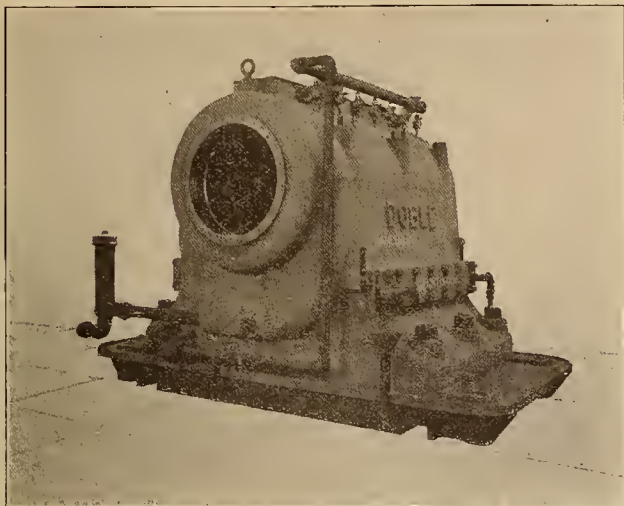
hung impulse wheels. Current is transformed from 6600 volts delta to 61,000 volts Y for transmission 47 miles to the Los Angeles main substation, by means of 9 single-phase, 3150 k.v.a. transformers, shell type, oil insulated and water cooled, there being one spare unit.

The water wheels were furnished by the Doble Water Wheel Company of San Francisco, which has since been absorbed by the Pelton Water Wheel Company. The main units operate under an effective head of 845 ft. and are rated at 14,000 h.p. each. They are fitted with water-economizer needle-nozzles, and Ensign vortex baffle plates. The exciter wheels are 450 h.p. machines. The governors have Lombard heads with Doble actuating mechanism. There is also a central governor oiling system of the closed type.

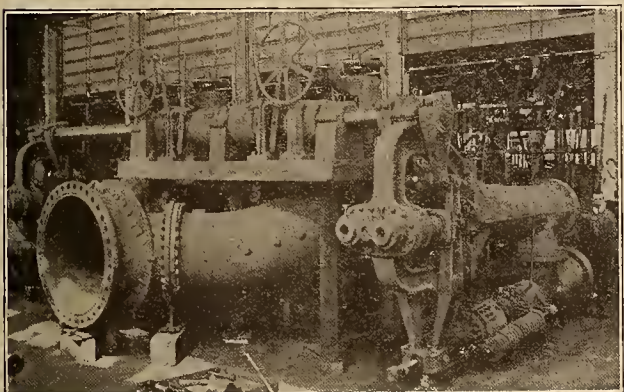
Transmission will be accomplished by means of two duplicate steel tower lines. The conductor is 300,000 cir. mil., 19 strand copper and the insulators are of the suspension type, consisting of seven 10 inch units.

The purpose of the present article is merely to show the present status of aqueduct power construction. Complete details as to costs and methods will be published later. At the present time the surge chamber has been finished. The power house is 95 per cent complete, including a 50-ton traveling crane. Transmission line towers are now being erected by gangs in the field. Excavation for the central receiving substation in Los Angeles is well under way, the foundations having been poured and work progressing rapidly. The machine shop, a two-story brick building,

is ready for occupancy. A substation has also been started at Garvanza, where over 4000 distributing poles varying in height from 35 ft. to 90 ft., have been erected. The East Los Angeles District has also been



Pedestal Bearing, with Sole Plate, Water Cooled Type.



Needle Nozzle Regulating Mechanism.

practically covered and as soon as poles are available work will be started in the Hollywood District. Bids are now being received for copper wiring and it is expected that this will be strung by the time that the plant is ready to turn over.

Iron conduit in concrete containing cinders, salt, sea water or other substance which has a corrosive action on piping, or if the concrete or cement in which the pipe is laid is to be exposed to brine, acid pickling bath liquor or other liquids of corrosive nature, or if the conduit is to be laid in contact with composition flooring, or similar structural material, should preferably be made up of pipe and fittings galvanized on the outside and should be painted with two coats of a pure red-lead paint, a bituminous paint or an equivalent protective covering. It is preferable that it also be wrapped or coated with an approved material for protection against corrosion.

Bare grounded return wiring systems are being investigated by a sub-committee of the general committee on electrical wiring systems, C. E. Corrigan of Pittsburgh being chairman. Information regarding experience with concentric wiring systems or ground connections is desired by the secretary, W. S. Boyd, 175 W. Jackson Blvd., Chicago.

ILLUMINATING ENGINEERING LECTURE COURSE.

BY G. H. STICKNEY.

Although many centuries have elapsed since artificial light was first produced, very little progress had been made toward effective lighting until the nineteenth century. The advance in the last decade has been incredibly great compared with any previous period. This remarkable acceleration has been due to two factors; the development of lighting units and the increased knowledge regarding their application. The latter being everybody's business was very liable to neglect. The Illuminating Engineering Society has been one of the most important factors in encouraging the determination and collection of such knowledge and facilitating its dissemination. The 1910 Lecture Course was the most notable event in the standardization of that knowledge. It logically gave its principal emphasis to the well determined principles of light production, distribution and utilization as scientific problems. Lighting practice as such was not sufficiently crystalized to permit of concrete and definite treatment. However, remarkable progress has been made in this direction during the past six years and the time is now ripe for a comprehensive inventory of lighting practice, based upon the excellent foundation laid in 1910.

The 1916 lectures at the University of Pennsylvania from September 21-28 will be of great value to those interested in the design of lighting installations, whether as purchasers, salesmen, engineers, constructors, physiologists or artists. Beyond the value rendered to those fortunate individuals who attend the course, there is a broader value which is bound to be realized, the same as in the 1910 course. The course will have a marked influence in advancing the art of illumination. Through its influence a better standard of lighting will be secured throughout the country. Inartistic and glaring light will be strenuously condemned and misconceptions rectified. The precious power of sight will be more carefully conserved.

Preliminary List of Lecture Subjects.

Subject.	No. of Lectures
(A) General	
(1) The Principles of Interior Illumination.....	2
(2) The Principles of Exterior Illumination.....	1
(3) Color in Lighting	1
(4) Architectural and Décorative Aspects of Lighting..	1
(5) Recent Developments in Electric Lighting Appliances	1
(6) Recent Developments in Gas Lighting Appliances...	1
(7) Modern Lighting Accessories	1
(B) Special Lectures on Interior Illumination	
(8) The Lighting of Factories, Mills and Workshops....	1
(9) The Lighting of Offices, Stores and Show-Windows.	1
(10) The Lighting of Schools, Auditorium and Libraries..	1
(11) The Lighting of Churches.....	1
(12) Theatre Lighting (including Stage Lighting) and the Lighting of Art Museum.....	1
(13) The Lighting of the Home.....	1
(14) Train Lighting	1
(C) Special Lectures on Exterior Illumination	
(15) Street Lighting	2
(16) The Lighting of Yards, Docks and Other Outside Works	1
(17) Headlights, Searchlights and Projectors.....	1
(18) Sign Lighting	1
(19) Building Exterior, Exposition and Pageant Lighting.	1

OUT OF DOOR HYDROELECTRIC PLANTS.

BY RALPH BENNETT.

(Detailed analysis is here presented of the slight changes in design of apparatus which would make it possible to dispense with power-houses as a protection for electrical apparatus. This paper was presented at the January meeting of the Los Angeles Section of the American Institute of Electrical Engineers. The author is a consulting engineer at Los Angeles.—The Editor.)

The rapid development of rugged types of transformers, of enclosed generators, of reliable insulators and the growth of the size of the units in the plants are all conditions favoring the elimination of much of the elaborate protection from weather which was necessary with the early apparatus.

The actual attention required by modern apparatus is slight. The labor expended in keeping blank cast iron surfaces wiped up, in sweeping and dusting the vast floors and wall surfaces, and in maintaining the roofs, windows and incidental apparatus is enormously greater than that actually expended on portions of the building actually essential to the active generation of energy.

A brief resume of the status of the art with particular reference to the possible use of complete out of door hydroelectric generating stations is of interest.

Transformers and Switches.

At receiving stations and at substations the use of out of door types of transformers and oil switches has already been developed into well accepted practice. Arrangements of high tension open air bus-bars of sufficient variety to meet any diagram of connections desired are already in use. The various types of suspension insulator have proven reliable and convenient. The initial cost of the tower structures and of the wiring compare favorably with enclosed bus-bar costs and the work is fully as safe.

The only serious problem on the transformers and switches was the high tension terminals. The more liberally designed types have proven as successful in the open as the indoor types.

The total space required is usually increased in such stations over that required for the indoor high tension work, but not to a serious extent. Provision for taking apparatus apart is usually made by building a small enclosed shop to which the injured unit can be wheeled. As but one crew can often be worked on the repairs such a single repair point rarely delays the repair work while it keeps the oil and repair parts well concentrated. Good practice provides this shop with a pit into which the transformer case can be lowered so that the coils are exposed at about the floor level.

This class of apparatus can receive but little detail attention while in service. Cooling water for the transformers can be led to any convenient point for observation. Leakage of oil can be observed, and leakage of electricity can sometimes be heard before a final breakdown. Cleaning of the exterior surfaces of the cases is of no particular value. Cleaning of porcelain or other creepage surfaces of "dead" transformers or switches can be the more easily accomplished the more open the surroundings. Knife blade disconnecting switches can better be set in the open with ample spacing than between confining walls to which an arc can form.

Generators.

Open type generators taking air from, and returning it to, the room require a dry, well ventilated power-house. They become dusty and must be blown out rather frequently. Open slip rings need protection and can be oiled from time to time to advantage.

Fully enclosed generators have come into general use in connection with high speed steam turbines. These units, including the rings, are completely boxed in with a cast iron case and take air from, and deliver it to, the outer air. They can receive no attention of merit while in service. If the incoming air is properly purified by screens and baffles, the dust and moisture which reach the winding are nominal in amount.

These generators have proven to be reliable in service and to be distinctly advantageous from the operating standpoint. Not only is the attendance reduced to external wiping and the watching of bearings, but the reduction of generator noise and the absence of excess heat from the machines render the generator room more comfortable.

Observation of internal iron temperatures, and even of the condition of the windings, is possible by means of thermostat windings placed in the interior of the machine during assembly. These may be, if desired, made to record, thus giving a permanent record of the usage to which the unit has been subjected.

There is no particular reason why this class of unit should not be operated in the open. Slight changes in the joining of the case, in the air connections and in the slip rings and shaft arrangements are all that would be necessary by the omission of all cover.

Exciters.

The demand for excitation and other direct current energy in a large, modern power plant calls for exciter units of considerable size. The water wheels driving them are of the same general type as are the main wheels and with their governors can be treated as are the larger units.

The exciters are now generally 250 volt continuous current interpole machines. They require no special attention and have so little commutator trouble that special accessibility is no longer as necessary as was the case a few years since. If completely enclosed and operated in the open they will still be subject to less severe conditions than are large enclosed mill and railway motors.

As their current flows are large the use of remote control main and field switches throughout is desirable. With such switches the location of the exciters near the main board is not a matter of importance as the only considerable advantage with a completely enclosed exciter would be short runs for the main leads to the board. Any location which suits the general layout of the plant will now be suitable.

Bearings.

A few years ago the only type of bearing in successful use required constant drip supply of oil. The modern motors are supplied with ring oiling bearing which go for many months without attention. Heavy generators have oil or water circulation which keeps them at any predetermined temperature. The piping from these coils can be led, as can the transformer cooling lines, to any selected observation point. If

desired the placing of thermostats or recording thermometers in these bearings can be easily arranged. As the bearing is of its necessary construction waterproof, it can as well be in the open as under a roof.

Governor.

About the only delicate and accurately adjusted piece of apparatus left in the modern power plant is the governor head. As now designed a water wheel governor consists of a plunger or plungers connected by link rods and bell cranks to the water control devices and a set of flyball controlled admission valves called the governor head. The form of the plunger system and the size of the cylinders in which the oil pressure is applied vary with the type of water control.

A common impulse wheel system has been the deflecting nozzle with a slow or hand operated needle. Of recent years the use of a set of two duplicate nozzles, one playing on the wheel and one wasting water, has been extensively introduced. Slow needles driven from the governor are used if water saving is desired.

Turbine control has almost completely narrowed down the use of heavy gate rings operating movable admission vanes. If a bypass is required it may be controlled from the governor or by the pressure rise in the pipe or from both sources.

But in any case the function of the plunger system is reduced to a simple firm stroke of a time and length predetermined by the governor head.

This head consists of a series of interacting parts applying their forces on a pilot valve which controls the main cylinder. Part of the interacting forces are a function of the speed derived from the flyballs driven from the unit. Part is an optional control by the station operator at the switchboard. Part is a provision against overrunning and part a provision against over-rapid action. These two are usually derived from mechanical connections to the governed mechanism.

As at present developed this head must be open for observation and readjustment to varying load conditions. But practice does not demand that it be placed directly upon the control cylinders. In fact it is rarely possible to so place it even though the designer wish the more accurate action which short pipes and rods are supposed to give. In large plants the separation is frequently 25 to 50 ft.

Doubtless this governor head should be housed and in a position from which the switchboard or central control position can be readily communicated with. Indicating dials showing the complete position of all parts of the governor head and of the cylinder system can be placed on the main control board.

Valves.

Modern gate valves may be placed at any convenient place and controlled by electric circuits from the main control board. There are no parts liable to get out of order which daily attention will help. The placing of proper watertight covers over the electric devices or of insulating jackets around hydraulic cylinders is necessary in open air installations, but has already become well developed.

Control Board.

In a thoroughly modern plant all the control, both electrical and mechanical, is centered in the main

control center. Here are meters, showing not only voltage, output and speed on every unit and on the total plant, but also recording devices which give permanent records of the output and the conditions of temperature and use under which that output was obtained.

This apparatus must be well covered and protected. At the same point the telephone station and the general office for the plant can be placed. From here all parts of the station must be easily reached and communicated with.

In any station some degree of separation between this delicate apparatus and the massive machinery on the main floor is made. The placing of the main room and the switchboard in separate buildings is sometimes considered good practice in steam plants of large size.

In severe climates the switchboard is almost always enclosed and this small room heated. While the efficient working of the board requires it, this has the disadvantage of providing a comfortable room into which all the floormen and operators are inclined to drift to the disadvantage of the station at large. If as is proposed in this article all the operating functions are assembled in this room, or in galleries extending from it, this natural grouping of the operating force becomes an advantage of the arrangement, bringing all the men to a central point ready for emergency service at any part of the plant.

Crane.

In the standardized power plant of today the main floor is supposed to cover and carry all heavy pieces of apparatus. For rapid handling during repairs there is installed a power-driven overhead travelling crane spanning the room and capable of lifting from 10 to 75 tons. Most of the actual routine work in the plant calls for the handling of pieces weighing a few hundred pounds. For these the crane usually has a small auxiliary hook. Most of the area enclosed in the plant is due to the height required to get efficient use out of this crane. Part of the floor area is due to the need of room beneath it in which to store parts of disassembled machines.

In an open air station a gantry crane spanning only the main machines will be used to handle the heavy parts. Its lift will be sufficient to carry parts over assembled units. It need have no spare width as storage can be placed beyond the power plant proper at any point to which the track can be extended.

Small parts and apparatus not under the main crane can be handled by a small motor-driven movable crane such as is used to serve lathes and planers in machine shops.

While being opened the electrical apparatus will need protection. For this purpose the gantry will be enclosed and fitted with side curtains sufficient to protect any apparatus beneath it.

The transformer yard and switching station would also deliver transformers and switches to the gantry by direct or cross tracks on which the units would be rolled until under the crane.

During construction the gantry tracks would be extended across a long materials yard in which parts would be stored entirely out of the way until needed,

Portion.	Enclosed Station.	Open Station.
Roof	Yes	No large enclosure.
Walls, windows	Yes	No large enclosure.
Floor	Yes	Yes, but smaller.
Basement	Part	Small.
Crane	Traveling	Gantry.
Craneway	On walls.....	On ground.
Area served.....	Apparatus and gangway.	Main units only.
Auxiliary crane.....	On main bridge.....	Portable on truck.
Lighting	General interior.....	Outdoor.
Exciters	Main room.....	Operator's room on main floor.
Main generators.....	Open	Enclosed weatherproof.
Main ventilation.....	Natural	Forced.
Noise	Extreme	Slight.
Bearing	Ring oiling.....	Water-cooled, tight caps.
Governor	Main floor	In operator's gallery.
Control board.....	Main room.....	Enclosed and containing all the mechanical and electric control and recording apparatus.
Wiring, low tension.....	Ducts	Ducts and open.
Wiring, high tension.....	Ducts	Open
Switches and transformers.....	In cells	Outdoor type.
Detail attention.....	Entire plant and building.	Governors, control board and indicating instruments.

As an example for comparison consider the Kern River Station of the Southern California Edison Company which the writer designed and built about ten years ago. The station, considered to embody the best ideas of the time, is still spoken of as an up to date plant.

Each unit consists of a 5000 kw. revolving field generator 2300 volts three phase 50 cycles running 250 r.m.p. driven by two impulse wheels overhung on the ends of the shaft. These two wheels are governed in common by a governor set opposite the generator. The control is by deflecting the nozzles followed by hand regulation of the needles.

The main valves are set in the generator room and have hand and motor control. Wasted water is "killed" on double baffle plates before reaching the tail race.

The transformers and high tension oil switches are set in concrete cells opening from the main room and arranged to deliver injured apparatus under the main crane.

At the time this station was built the suspension insulator was undeveloped and the outdoor switch and transformer not yet possible. 75,000 volt leads under even the most careful protection were considered to be a great hazard.

The crane span and lift were kept to the extreme minimum which would permit of handling the parts of the machines. The clearance is insufficient to permit of lifting out the active parts of a transformer and a pit to the basement is provided into which the case is lowered when the interior is to be removed. This arrangement, made as a move toward economy, has proven to be advantageous as both the case and the coils are accessible from solid floors.

In the proposed alternative station the same general dimensions are used for the apparatus, although it is possible that the other alterations would result in a considerable decrease in sizes for the same output.

The same type of speed control is shown. It is likely that a new plant would have the other type of control, but the space used would be nearly as great.

The separation of the governor head and the cylinders would be less than is already in use at the Big

Bend plant of the Great Western Power Company and elsewhere. The decrease in the enclosed areas, 434,000 cu. ft. in the old to 22,050 cu. ft. in the new style plant, is so great as to warrant careful study.

The floor areas do not vary so much, as the outdoor generating apparatus will require about the same foundations as will the others, while the foundations for the outdoor transformers and switches will be nearly as massive as those they would be set on inside, while the walks and runways to reach them would be longer.

There is a consideration in this connection which is more important than first cost and operating facility and that is safety. Not only would enclosed generators be free from accidental injury due to leaky roofs or careless handling of other objects while close to the generators, but they would also be free, if installed in the open, from danger due to the failure of any part of the adjacent units.

There have been many cases of the complete destruction of the contents of waterpower plants, and almost without exception the damage has progressed from one unit to another due to open construction in a restrained area.

At a well known plant in Oregon a governor failed to control the speed. The generator eventually exploded from excess speed and flying parts damaged other governors, while flames from the shortcircuited windings completed the destruction of the entire equipment.

A runaway wheel in an outdoor plant could completely vanish without disturbing the neighboring units.

At a large station in California equipped with high head turbines and open type generators, a cast iron wheel case burst and flooded the powerhouse. Between water and fire the generators, wiring and governors were practically ruined.

In an open station the flow from an injured casing, even the full flow of a broken penstock, could cross the floor and flow away without wetting any perishable part.

When utility, economy and safety can all be satisfied by a new construction to a greater extent than by an old, it is but a brief time until the newer work must become popular.

Evaluation of Portland Railway, Light and Power Company has been completed by the Oregon Public Utilities Commission after three years investigation. The reproduction cost new of the utilities is fixed at \$45,375,027.19 in preliminary findings of fact. Upon this as a basis the commission will next determine rates. The inventory and appraisal submitted by the utility claimed a total value of all its property, including its value as a going concern, as of June 30, 1915, of \$61,040,004. In this figure the utility included \$7,489,446 as "going value," which is not included in the figure found by the commission. The commission also reduced the utility's claim for water right and real estate value, reduced percentages for overhead costs and decreased the amount claimed as working capital.

PROSPECTIVE POWER MARKET FOR IRRIGATION PUMPING.

BY JOSEPH JACOBS.

(Continued.)

Celilo power costs.—In the preliminary report upon this power project, rendered in 1912, a base rate of \$9 per h.p. at the generating station was named for general power and \$5 per h.p. per year was named as a possible charge for irrigation power, this latter figure being less than cost and in the nature of a subsidy to agricultural development, any immediate loss involved therein to be absorbed in the rate fixed for general commercial power. Such action might be entirely justified, but it would no doubt require legislative authority and the lower figure could not, therefore, be adopted as a basis for present estimates.

It is my understanding that the more recent studies of the Celilo development give no warrant for lowering the figure first above quoted and one suggestion as a rate for irrigation power has been as follows: A base rate of \$9 per h.p. per year at the generating station, to which would be added a rate to cover the annual cost of transformation and transmission, these rates to be on a connected load basis and the full yearly charge to be made for the irrigation season on the assumption that there would be no market for the auxiliary power during the non-irrigation season. This would impose upon irrigation a rate in excess of that charged for all year industrial power, and it seems to me it should be somewhat reduced for the following reasons:

- a. It is probable that a winter load to the extent of at least 5 per cent of the summer irrigation requirements could be developed; the normal demand for light and heat and general purposes other than irrigation being greater in the winter than in the summer. On the Minidoka project in Idaho, a winter load amounting to about 15 per cent of the summer irrigation load has been developed.
- b. Depreciation of the generators and turbines at the power plant for a seven months' operating season would be appreciably less than that for a twelve months' operating season.
- c. Cost of attendance at the power station would be somewhat reduced.
- d. Cost of waste, lubricants and miscellaneous repairs to generators and turbines would be reduced.
- e. The maximum load paid for by irrigation would not be carried at the power station, and furthermore peak loads for the different projects would not occur at the same time, and the power house installations therefore would probably not need exceed 75 per cent of the total connected irrigation load, assuming a large irrigation development.

Taking cognizance of all of these factors, I think it probable that the actual cost of delivered power, taken on a basis of connected load and for the average irrigation season, would not be in excess of 80 per cent of the cost of all year continuous power, and while I have hesitated to take this figure as basis for my estimates I have adopted as a rate for irrigation power 90 per cent of the cost of all year continuous power.

Limiting power costs.—The limiting charge for Celilo power delivered at any particular point would be a price at which power from other sources could be

delivered to the same point. In some cases competition will be had with nearer electric power developments, whose shorter transmission distance will make possible rates at which Celilo power could not be delivered. In other cases, where long transmission and small amounts of power are involved, and because small amounts of power cannot be economically transmitted long distances, competition might be had with steam or gasoline or gas engine plants. The more recent developments in the field of internal combustion engines forecasts a certainty of very cheap power from that source, and I am of the opinion that by the time the Celilo power could be made available such plants will be able to compete with electric power at one-half cent per kilowatt hour for Columbia River points in Oregon and Washington.

Engines of the Diesel type, for instance, which for the first dozen years of their exploitation in this country were somewhat experimental and perhaps two complicated, are now offered by several American manufacturers upon a reasonably safe and conservative basis both as regards price and constructive details. The best recent tests of this type of engine have shown fuel consumption as low and in some cases lower than one-half pound of crude oil per brake horsepower hour, which for California petroleum means from 1/15 to 1/16 gallons per horsepower hour, or approximately 1/12 gallon per kw.-hr.

The present price of crude oil for North Pacific Coast points is about 85 cents per barrel, or 2 cents per gallon, and at present railroad freight rates I estimate that its cost laid down at pumping stations along the Columbia River will be from 4 cents to 4½ cents per gallon. The cost of fuel alone, therefore, would be about 0.35 cents per kw.-hr. and including an allowance for interest, depreciation, taxes, attendance, lubricants, etc., I estimate a total present cost of approximately 0.80 cents per kw.-hr. for installations of 200 h.p. capacity.

Comparing such an installation with one having an electric motor drive we must include in the latter the cost of switchboard, stepdown transformers and the motors themselves and excitors for same if the motors are to be of the synchronous type. The cost of all these in place, however, would probably not exceed one-third the cost of the oil engine installation above considered and the fixed charges on same would therefore be proportionately less. Exclusive of the cost of electric current I estimate the power cost for this installation to be 0.17 cents per kw.-hr., thus leaving a margin of about 0.63 cents per kw.-hr. as available for electric current to place the two types of installation on a parity as to final cost of power.

Looking ahead, however, we may confidently anticipate a reduction in factory cost of oil and gas engines and, with the improvement of the Columbia and Snake Rivers for steamer transportation, we may also anticipate a material reduction in freight rates to river points. The former would reduce fixed charges and the latter would reduce fuel costs for all pumping installations of that character and these conditions are my premise for the assertion made in the initial paragraph that such plants would later on be able to compete with electric power at one-half cent per kw.-hr. I have therefore thought it proper to ex-

clude all projects, however attractive they might be, where it appeared that the cost of delivered Celilo power would be in excess of that figure and a number of small projects were thus eliminated.

Permissible lift.—I have sought to determine in a general way what pumpage lifts would be economically permissible with irrigation power at rates that the Celilo development would make possible. In pursuing this study I considered a project of 10,000 acres and a farm unit just sufficient to comfortably support a family. I shall not enter into the detail figures of this study at this time further than to say that every item of possible expense attaching to farm operation was included; that land and water right was assumed to cost \$100 per acre; that interest was taken at 6 per cent and taxes at 1 per cent of the total investment; that ample depreciation was allowed for all buildings and equipment on the farm; that an allowance of \$720 per year was made to the farmer for his own labor and that conservative figures were adopted for crop yields and crop prices.

The classes of farm investigated and the resultant permissible lifts, upon the bases assumed, were about as follows:

For a 20 acre fruit ranch, representing a total investment of \$10,000, a permissible average lift of 1000 ft.

For a 30 acre, one-half fruit and one-half forage ranch, representing a total investment of \$11,855, a permissible average lift of 300 ft.

For a 30 acre dairy ranch, representing a total investment of \$8,920, a permissible average lift of 35 ft.

For a 60 acre forage ranch, representing a total investment of \$9,940, a permissible average lift of 25 ft.

A considerable variation of judgment may obtain as to the several items of cost entering the estimates upon which the above deductions are based, all of which variations will appreciably affect the permissible lift. The result may be to make any single set of figures somewhat illusive or misleading and, therefore, to require the most conservative judgment in their interpretation. If, for instance, the allowance to the farmer for his own labor were changed from \$720 to \$600 per year, and the latter figure is nearer the average for the United States, it would provide an additional \$120 per year for pumpage and would permit lifts for the 30 acre dairy ranch of about 200 ft. instead of 35 ft., and for the 60 acre forage ranch of about 110 ft. instead of 25 ft. as above stated.

The 1000 ft. permissible lift for the 20 acre fruit ranch may well challenge the credulity of some and yet for the conditions assumed; to wit: a project with soil and climate truly adapted to good fruit culture, I do not regard the figure as extravagant. Because of its magnitude, however, and to illustrate the general method of arriving at these permissible lifts I offer, in Appendix A, the detail figures for this case, and I think it will be promptly conceded that the assumptions made therein are entirely conservative.

It would appear from these studies that only those lands contemplating the lower lifts could be devoted exclusively to forage culture or to dairy farming and that the higher bench lands must be devoted largely to fruit and vegetable culture or pumpage to them would be economically impossible. It should be borne in mind too that no extensive body of land in a single project is exclusively adaptable to fruit culture, and

also that diversified farming, with respect at least to the project as a whole if not to the individual farm, is always the wiser plan. These causes would at once inhibit the 1000 ft. lift applicable to the all fruit farm and I think it may be safely assumed that the maximum average lift can practically not exceed 400 ft.

Another important fact disclosed by this study is that from \$9,000 to \$12,000, as will be noted above, are required to bring these farm properties to a status of normal yield and profit. This indicates clearly the necessity for some form of rural credits and of so financing these projects that the farmer may secure the lands upon long time payments and easy terms in order that he be not crushed during the early years of his establishment upon the farm. This is a most significant fact and I apprehend that failure to so finance these enterprises, whether under some form of government sponsorship or otherwise, will invite disaster or at best impose a most serious handicap on the settler, on the project and on general state development.

(To be continued.)

REPORT OF N. E. L. A. ELECTRIC RANGE COMMITTEE.

(Continued.)

Apartment House Cooking.

The electric range is peculiarly well adapted for apartment house service. The character of construction of the buildings, and the mode of living of the tenants, make it ideal.

Space in an apartment house especially in the kitchen is usually limited. The advantage of a compactly constructed electric range is therefore apparent.

A range in an apartment is only needed for cooking operations, as hot water and heat are usually supplied from the basement. This condition makes the electric range far superior to fuel burners.

Apartment house tenants move frequently. Each new occupant insists on having the woodwork repainted and the walls retinted and repapered. The very nature of the electric range which does away with all smoke, grease, dirt, and filth makes this expenditure on the part of the owner unnecessary.

The utensils used on an electric range are easy to clean both inside and out on account of the absence of soot and burned foods. This makes the kitchen work easier, quicker and more attractive to the tenants.

Silverware tarnishes quickly where fuel stoves are used. Such is never possible, however, where the cooking is done electrically, as there are no products of combustion.

Many people are careless and fuel stoves in apartment houses are a constant menace. The danger of loss of life and property by fire is entirely removed where electric ranges are used.

Occupants may be asphyxiated by the use of gas as a result of the supply being temporarily cut off; on account of children carelessly opening the valves; or through mistake of the cook or housewife. The user of an electric range is absolutely free from all danger.

The ventilation in apartment house kitchens is often very poor and where some fuels are used the fumes are poisonous and the fire is constantly burning oxygen out of the air. The electric range on the other

hand gives off no poisonous fumes and destroys no oxygen whatever.

Small kitchens being the rule rather than the exception in an apartment house, the heat from a fuel range often becomes unbearable. The housewife using an electric range can dress before preparing a meal and be assured that she will suffer no discomfiture whatever on account of the heat.

From the central station company's standpoint the apartment house business is very desirable. The load is mostly of an off-peak character. The load factor is good. The diversity factor is not excelled by any other class of business and the demand is high. Curves taken on several large apartments show that the connected load in cooking apparatus is often as great as seven times that of the maximum demand. The apartment house business is easily the most attractive cooking load that can be secured.

It is the opinion of the sub-committee that the magnitude of the electric range business in the future is largely, if not entirely up to the manufacturers to determine. In other words, the efficiency, durability, flexibility and price of the coming electric ranges will govern the volume of business which is to be handled.

It is apparent that in the Pacific and Rocky Mountain states the central stations are alive to the importance of this field of development, and it is also apparent that an interest is being created in electric cooking in all parts of the country from the Pacific to the Atlantic. The public is becoming curious as to what are the advantages of electric cooking, and this curiosity may be easily changed to desire, if the products of the manufacturers fulfill the requirements and meet the conditions laid down.

There must be constant improvements in developing the range itself. At the present time it has become the custom to say "develop the electric range along the lines of the modern gas range." This is a good basis upon which to start, but the future development of the electric range may be along lines of its own, rather than a continual imitation of the gas range.

When the first automobiles were put upon the market they resembled buggies and carriages formerly drawn by horses, but gradually the automobile manufacturers have developed machines with entirely different lines, better adapted for the work which is put upon them. It is quite probable that the development of the electric range will point in a similar direction.

For some time past there has been a fear on the part of electric range manufacturers and central station managers that the electric cooking load would seriously affect the daily and annual peak of the central stations, and consequently there was a tendency to keep down the size and capacity of the burners. However, experience has demonstrated that the cooking load will not seriously affect the peak, and that under ordinary conditions, owing to the diversity factor, not more than 10 per cent of the connected load in electric ranges is likely to come upon the peak at one time. Consequently there need not be the fear of increasing the capacity of the burners so that the cooking may be done more quickly, and thus better meet the competition of other fuels.

The most important factor in the satisfactory operation of an electric range is the heating element. It is essential that the burners be constructed initially so that they will be able to withstand the use and abuse which may be put upon them. It is absolutely essential that the heating elements which are liable to burn out should be readily and quickly replaced, so that there may be no unnecessary delays in repairing. The average housekeeper is willing to pay the price for the service upon the condition that cooking can be done quickly, and with as little trouble for repairs as is caused by other cooking appliances and other fuels.

The majority of central stations interested in the development of the electric range business are willing and anxious to make liberal expenditures and concessions in order to induce consumers to cook by means of electricity, and such matters as adjustment of rates and local advertising will undoubtedly receive the attention they deserve from central station managers.

The manufacturers will still require to co-operate with the central stations after sales have been made, so that owners of electric ranges may be thoroughly instructed regarding their operation and durability. It is as much to the advantage of the manufacturer to follow up a sale as it is to the central station and such work intelligently done will produce results which will be altogether desirable.

The properly constructed electric range has all the good points of older methods of cooking without any of their disadvantages. It has also many advantages which are not possessed by other cooking appliances. However, the public is not informed regarding the advantages and operation of the electric range, and while interest is being created in the subject, there is still a note of interrogation in the public's mind. Education and demonstration will overcome doubt and want of knowledge, and the proper education of the public can only be brought about by the earnest co-operation of the manufacturers themselves and then between the manufacturers and the central stations.

(To be continued.)

The U. S. census of the gas industry for 1914 shows that of 1284 establishments reporting, 427 produced carbureted water gas; 274, straight coal gas; 156, mixed coal and water gas or mixed coal, water and oil gas; 150, oil gas, and 165, acetylene. The principal product of the remaining establishments, 112 in number, was gasoline gas. The 150 oil-gas plants included 61 which manufactured Pintsch gas and 4 which produced Blau gas; and the 165 acetylene plants included 36 which distributed the gas in containers. The gas products and 1 each in Arkansas and Wyoming. The gas products comprise 203,730,191,000 cu. ft. of gas, valued at \$175,065,930, consisting of 10,509,946,000 cu. ft. of straight coal gas, valued at \$10,726,514; 90,017,725,000 cu. ft. of carbureted water gas, valued at \$74,516,534; 86,281,339,000 cu. ft. of mixed coal and water gas, valued at \$72,012,021; 16,601,805,000 cu. ft. of oil gas, valued at \$15,044,509; 137,964,000 cu. ft. of acetylene, valued at \$2,511,634; and 181,412,000 cu. ft. of other gas, chiefly if not entirely gasoline gas, valued at \$254,718.

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The semi-annual index for Vol. XXXVI, which is completed with this issue, will be sent upon request to any subscriber.

The remarkable results attained in the scientific management of factories have frequently been referred to as indicative of what might be accomplished with more scientific management of electric power companies, scientific management being considered as a means for lessening cost of output. While this view is, in a measure, true, the business of supplying electric current differs from the business of making machinery in that the output of one is service and the other pieces.

In the power business, reduction in cost must yield precedence to safety first and continuity of service. One of the chief points of difference between a power plant and a manufacturing plant is that the selling price of the former's product is based primarily upon the character of the service rendered. New ways of enhancing service to the public are needed more than new ways of lessening costs.

The wonderful increase in efficiency of plant operation has been due primarily to the manufacturer of the apparatus employed. Boilers, prime movers and generators show increasingly higher efficiencies. These, in the aggregate, are far greater than any economies that may be effected by more efficient operation of the apparatus.

The commercial side of a proposition often preponderates over any saving that might be made by its adoption. A power company finds that it can make certain articles cheaper than they can be bought from the regular manufacturer, but may be faced with the fact that the manufacturer as a power consumer pays many times the proposed saving for the current he uses.

This does not mean that every effort should not be made to find costs, but merely that any suggested reduction be tempered with judgment. It does not mean that there should be any let up in trying to improve operating efficiencies, for in this way it is possible to improve service and further safety without increasing rates.

Now that assertion of the management's personality has enabled most public service corporations to live down the stigma of soullessness it is time that the corporation begin to cultivate a few personal attributes. The noblest of these personal acquirements, and the one most to be sought, is the capacity for friendship. A corporation without friends is more to be pitied than a man in similar plight.

Many a man has lived to regret the day when he thought that he had no time to make friends. With a corporation the situation is even intensified; friends are an asset worth cultivating. Any corporation may well ask itself what is the value of financial success if, in attaining it, friendships have been sacrificed.

A corporation's closest friends should be its em-

Scientific Management of Power Plants

ployees. When they are always looking out for its interest, saying a good word for it at every opportunity, stopping slanders, nailing lies, correcting false impressions, and overcoming prejudices created by some mistake, the public, in turn becomes friendly. The private acts of employees can do more to make or mar public feeling toward a corporation, than the public acts of the corporation's officials.

Friendship is impossible without reciprocity. The only way to have a friend is to be one. In order that a corporation gain the esteem and respect of the public it should exhibit a similar esteem and respect toward the public. Friendship must be given before it can be taken.

Friendship is sincerity dissolved in sympathy. The strength of the solution depends upon the sincerity of the motive prompting friendship. The mutuality of friendship and consequently its existence is destroyed by pretense. Without truth there can be no friendship.

Sympathy is the universal solvent without which no motive can be understood. It is sympathy, or tenderness, that also gives friendship its evanescence. Like the most delicate blossom it disintegrates with the lapse of time.

Emerson once wrote something about conversation being the consummation of friendship. For the group friendship, symbolized by public good will, publicity and approachableness, are the substitutes for private conversation.

Such publicity should be largely directed toward showing the public how it is being benefitted by the corporation service. It should be calculated to win and hold public confidence.

To build a hydroelectric plant out of doors, on first thought, seems a most startling innovation. But as detailed elsewhere in this issue by Mr. Ralph Bennett, the advantages of so doing in some respects are greater than the advantages of an expensive structure built to protect the apparatus against the weather. This is particularly so in the Pacific Coast localities where inclement weather is the exception rather than the rule.

Approved modern practice in the construction of power plant apparatus has tended more and more toward complete individual housing. But few changes in design would be necessary to provide watertight cover for every device. The resulting reduction in first cost may offer a solution to the problem of hydroelectric competition with steam power plants. Furthermore, safety would be enhanced and operation would be facilitated.

The criticism that this proposal has provoked brings to mind the caustic comments on the first outdoor substations. That the outdoor substation has since proven an unqualified success suggests that judgment at least be withheld until the idea has been tried out in practice.

The chief function of the engineer has always been to combat weather. In designing a bridge, a transmission line or a building, due allowance is always made for wind pressure. Wherever people are housed adequate protection must be provided to temper extremes of heat and cold. Comfort and health also require that rain and snow should be excluded. But when sufficient cover is provided for operators, and when each machine is individually protected, some of these precautions seem unnecessary in power plant construction.

Talking of the weather, except for sailors and farmers, no class of people are more interested in climatology than engineers. Probable temperature extremes always govern engineering design, if for no other reason than to guard against expansion and contraction. Records of rainfall are indispensable as a guide for irrigation and water power plants. However, it should not be forgotten that disastrous experiences have demonstrated the danger of too much reliance on such data, or at least of an improper interpretation thereof. The failures of several Western irrigation projects due to this cause furnish evidence not to be forgotten.

Another weather factor to be considered by the engineer is humidity, which greatly influences the design of cooling ponds for refrigeration or condenser work. San Francisco, with a summer humidity of 75, requires greater cooling surfaces than Yuma with a humidity of 16 or less.

Other instances will undoubtedly suggest themselves to the reader as to the desirability, from an engineering standpoint, of a continuous and accurate record of atmospheric pressure, temperature, rainfall, direction and velocity of the wind, and evaporation. If for no other purpose than to construct dams, spillways, headworks, bridges and levees against floods, such information is essential to the well-being of the people.

Considerable criticism has lately been directed against the U. S. Weather Bureau for negligence in furnishing more complete information in this respect. Several Southern California members of the American Society of Civil Engineers have contributed papers and discussions to the Society's Proceedings. Strangely enough the answer to these criticisms was published in the Journal of the Cleveland Engineering Societies nearly a year after the first paper was published. The main points in extenuation were that the Bureau was doing the best it could with the means at its disposal and considering the needs of other classes besides engineers.

Further presumption on the license which is afforded by the changeableness of the subject of this desultory discourse makes it opportune to also call attention to the effect that the weather has on labor conditions on the Pacific Coast. Snow is almost unknown except in the extreme north or at the highest altitudes. Construction work usually proceeds uninterruptedly throughout the winter. In the summer also there is seldom such a combination of hot weather and great humidity as to hamper workers.

PERSONALS

H. J. White, manager of the Keeler-White Company, at San Francisco, is in Chicago for a month.

Paul M. Lincoln, engineer with Westinghouse Electric & Manufacturing Company, is at Los Angeles.

H. J. Verfurth, of the Central California Electric Company of Lindsey, was a recent business visitor at San Francisco.

G. F. Chellis, formerly with the J. G. White Engineering Corporation, at San Francisco, is now located at the New York office.

B. J. Klein, Pacific Coast manager of the Bristol Company, has just returned from a short business trip throughout the San Joaquin valley.

W. S. Greenfield, manager of the San Francisco office of the H. W. Johns-Manville Company, is at Los Angeles to be gone for a couple of weeks.

C. C. Hillis, general manager of the Electric Appliance Company, recently returned to San Francisco from a short business trip to Los Angeles.

Jas. F. Pollard, assistant engineer California Railroad Commission, has returned to San Francisco from his annual vacation and resumed his duties.

Jos. Thieben, manager of the Panama Electric Lamp Company at San Francisco, is leaving for a three weeks' vacation at Pines, in Madera county.

Roy S. Roylance, mechanical and electrical engineer of San Francisco, has left for Kennedy, Humboldt county, Nevada, where he has engineering and mining interests.

C. A. Reynolds has resigned as member and chairman of the Washington Public Service Commission, to enter into private law practice. No successor has as yet been considered.

J. Skog, who controls one of the largest electric power concerns in Sweden, is a recent visitor at San Francisco. Mr. Skog has been on a tour of inspection of the power plants of the United States.

C. F. Green of the E. L. Knight Electric Company, of Portland, Oregon, has gone to the National Electrical Contractors' Convention, in New York, as official delegate from the Oregon association.

S. P. Russell, manager of the electrical department of the H. W. Johns-Manville Company, has returned to San Francisco from a two weeks' trip to Los Angeles. Mr. Russell leaves for Fresno next week.

W. C. Miller, of the Southern Pacific Company's electrical staff, left this week to attend the annual convention of the American Institute of Electrical Engineers as the delegate from the San Francisco Section.

H. H. Corey has been appointed member of the Oregon State Public Service Commission to succeed **Clyde A. Aitchison**, who resigned to become solicitor to the National Association of Railroad Commissioners. Corey has been secretary of the commission and at the May primary was nominated as the Republican candidate for commissioner from the eastern Oregon district. **Edward Ostrander**, who has been examiner for the commission, succeeds Corey as secretary.

W. A. Kraner, of the McClenahan-Kraner Carter Co., Inc., engineers and contractors of San Francisco, recently secured a \$175,000 contract for the irrigation development of the Alpaugh Irrigation District of Tulare county, which consists of 26 miles of distribution system of riveted steel pipe lines, five 12 in. wells 1250 ft. deep, 8 new pumping installations on the present wells, 65,000 gal. 100 ft. steel tower and tank with a pumping station for domestic supply purposes and it also consists of rebuilding six miles of the old canal.

Elmer Dover of Tacoma has been succeeded as president of the Oregon Power Company, a Byllesby interest, by **James A. Green**, who has been manager of the Northern Idaho and Montana Power Company, of which Mr. Dover is president. **Attila Norman** remains as vice-president and general manager of the Oregon Power Company, of whose Willamette Division **J. L. White** of Albany becomes manager. **A. L. Martin** of Dallas is manager of the Coos Bay division and **R. U. Steelquist** of Corvallis has charge of the Dallas division, under the new plan of reorganization.

MEETING NOTICES.

Los Angeles Jovian Electric League.

Every loyal Jovian was present at the luncheon on Flag Day, June 14th, and later marched in the preparedness parade. **Henry F. Holland**, president of the League, occupied the place of honor at the head of the Jovian League, which lead the electrical and lighting division, which was one of the largest and most representative departments of the procession. The spirit of the day was strongly in evidence at the luncheon, being manifested in stirring, patriotic songs and speeches, the guests of honor being **Hon. Geo. S. Patton**, **General Harrison Gray Otis**, and **Paul Lincoln**, junior past president of the American Institute of Engineers. **Geo. S. Patton** in his address, predicted that the close of the war would mark a new epoch in the history of the world and the most dangerous and trying era that America has ever faced. **General Otis** also delivered a brief address, in which he spoke of the career of **Major-General J. Franklin Bell**, Commander of the Western Department, U. S. A., **General Otis** also exhibited the flag of the 8th Army Corps, which was carried through the Philippine campaign. **Major-General Bell**, who was to have addressed the league on the subject of "Preparedness" was unable to be present. **A. E. Peat** was chairman of the day.

Portland Sections of N. E. L. A. and the A. I. E. E.

The last meeting of the year was held Tuesday evening, June 13th, at the University Club, Portland, Oregon. The following officers were elected to serve for the coming year for the local section of the N. E. L. A.: **J. C. Henkle**, chairman; **E. F. Whitney**, vice-chairman; **H. H. Schoolfield**, secretary; **C. L. Wernicke**, treasurer. **A. C. McNicken** acted as chairman pro tem in the absence of both the chairman and vice-chairman of the section.

The results of the written ballot for officers of the local section of the A. I. E. E. was announced as follows: **L. C. Merwin**, chairman; **J. C. Martin**, secretary; **E. D. Searing**, **A. S. Moody**, **P. Lebenbaum**, executive committee.

J. P. Groden was the toastmaster at the banquet and the entertainment committee provided the Progressive Business Men's quartet, the Russian dancers from the Hippodrome Circuit, and the Messur Sisters from the Pantages Circuit, as special features for the evening. Short talks were made, during the evening, by Messrs. **Lebenbaum**, **Schoolfield**, **Merwin**, **Coman**, **Henkle** and **Coldwell**. All the speakers agreed that the prime factor in making the meetings of the past year a success was due to the excellent work of the entertainment committee. The average attendance at all the various meetings during the year was 63. The attendance at the banquet was 85.

San Francisco Electrical Development and Jovian League.

The June 14th meeting was opened with a stirring address on preparedness in general and the proposed preparedness parade on July 22d in particular, by **Col. Mathewson** of the National Guard. On motion duly made and seconded the league agreed to do all in its power to induce its membership to march in the parade under the leadership of President **E. M. Cutting**. **Mr. F. E. Boyd** of the General Electric Company, as chairman of the day, then introduced **Rev. Albert W. Palmer** who gave an inspiring and helpful talk on "Personal

Efficiency." After analyzing the several motives which induce a man to desire efficiency, the highest of which is that cosmic patriotism known as religion, Mr. Palmer first outlined the necessary preparatory steps to personal efficiency, as exemplified by Mr. Purington and then recited the seven fundamental elements of efficiency. Self analysis was given as the first preparatory step, followed by a definition of limitation to determine special aptitude. Then follows a thorough study of the lives of those men who have succeeded along the selected vocation and the beginning of the new life, an effort to improve general health to acquire a more optimistic attitude and to strengthen moral qualities. Mr. Palmer's suggestions as to the seven essentials are (1) integrity of character, a straight, clean, honest and dependable life to inspire the confidence of others, (2) good physical health, planning to do your best work after attaining an age of 50 years, when the background of knowledge and accumulated experience can be the basis of such a work as was done by John Hay, (3) the ability to concentrate and to analyze the job after concentrating, (4) poise and the ability to forget a wrong and not cherish grudges, (5) teachableness, flexibility of ideas and the meeting of disappointment philosophically, (6) co-operation as instanced by welfare work calculated to improve the mental attitude of co-workers, and (7) a form of recreation supplying the features of all-round development lacking in one's regular business, for which church-going is recommended. Mr. Palmer's hopeful talk was more vigorously applauded than any yet given at the league luncheons and heartily bespoke appreciation of his address.

TRADE NOTES.

The Kimball Electric Company of Oakland has established a branch office in the Sheldon Building, San Francisco.

The National Electric Company of San Francisco have installed a large wiring contract for Dr. B. K. Smith at 840-42 Hayes street, and also at Twenty-first and Howard streets.

The Aero Fire Alarm Company has just finished the Letterman General Hospital, Presidio, San Francisco, contract, for installing a complete modern fire extinguishing system.

The Drendell Electric Mfg. Co. are installing the switchboards for the new San Francisco Library and have recently completed a new Safety First board that is always a necessity in public buildings.

The Northwestern Electric Company has opened a handsomely equipped free cooking school in the Pittock block, Portland, and will conduct classes in home economics. Mrs. L. M. Hayes, home economist, who will have charge of the lectures, is a well known expert in the line of home economics, and her lectures promise to be of unusual excellence and value. The new "Cook by Wire" store is tastefully finished in white enamel throughout.

Charles T. Phillips, consulting engineer, at San Francisco, has just completed plans and specifications for the electric wiring and illumination of the twelve story office building that will be erected on the corner of Second and Market streets, San Francisco, for the Savings Union Bank & Trust Company. These plans were prepared for Mr. John S. Drum, President of the bank. The Santa Fe railroad offices will occupy the first four floors.

NEW CATALOGUES.

"Something in It for You" is the striking title of an attractive booklet just issued by the Westinghouse Electric & Manufacturing Company in order to assist its agents and dealers in marketing the Westinghouse Electric Range. This booklet describes in a brief concise manner the advantages of this type of range together with a number of illustrations, and in addition outlines several methods of selling them and gives some suggestions covering newspaper advertising, window trims, demonstration, etc.

CALIFORNIA ELECTRICAL CONTRACTORS' WINDOW DISPLAY SCHEDULE.

Week of July 19th to 20th—Irons. With suggestions for summer use.

Week of June 26th to July 3d—Fourth of July decorations with flash-lights, fans.

July 3d to 10th—Vacation needs, vacation comforts. A few flash lights, water heaters, small fans, shaving cups, No. 92 plug clusters, toasters, cone shades, percolators, lamps.

July 10th to 17th—Fans.

July 17th to 24th—Heating appliances, grills, toasters, etc.

July 24th to 31st—Vibrators, vacuum cleaners.

July 31st to August 7th—Lamp display.

August 7th to 14th—For late vacationists. Repetition of July 3d to 10th window with a few alterations in trimmings.

August 14th to 21st—Miscellaneous everything electrical.

August 21st to 28th—Batteries, bells and push buttons.

CONVENTION OF CALIFORNIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS.

The Seventh Annual Convention of the Association will be held at Stockton, July 14-16, 1916. The following program is tentative:

Friday, July 14—

8:00 a. m.—Executive committee meeting.

11:00 a. m.—Opening of the convention; address of welcome, etc.; business session (for members only).

2:00 p. m.—Joint meeting of members C. A. E. C. & D., Jobbers and central station members. (Note: A card tournament has been provided for the entertainment of the ladies during the afternoon. Valuable prizes for the winners.)

7:00 p. m.—Roof garden dinner dansant. (Admission to all ticket-holders.)

Saturday, July 15—

8:00 a. m.—Unfinished business; election of officers. (members only.)

10:00 a. m.—"Trade Acceptances," address by Mr. Russell Lowry, president the First National Bank of Oakland, Cal.

2:00 p. m.—"Our Relations to the Mercantile World." Addresses by men prominent in the architectural, mercantile, hydroelectric and organization fields.

Auto tour through surrounding territory.

7:00 p. m.—Banquet. (Admission to all ticket-holders.)

Sunday, July 16—

Steamer trip on the sunny San Joaquin.

As this entire period is the season for flash light sales, it is suggested that when they are not displayed in windows they be put in prominent places inside the store.

ORGANIZATION OF ENGINEER BATTALION FOR MEXICAN SERVICE.

Immediately upon notice of the seriousness of the Mexican situation, Mr. J. W. Swaren of San Francisco, who has been taking an active interest in the Engineer Corps of California, conferred with officers of the regular army and decided to organize an engineer battalion to be associated with the National Guard of California. This is being organized in the expectation of active service. All engineers qualified to serve as commissioned or non-commissioned officers are urged to present their qualifications at once, as a necessary preliminary to the enlisting of mechanics as first and second grade privates. Further details regarding this matter will be published next week.



NEWS NOTES



ILLUMINATION.

SAN ANSELMO, CAL.—Property owners have petitioned the city trustees to install electroliers along San Anselmo and Bolinas avenues.

SEATTLE, WASH.—A franchise has been granted to the Lake Forest Light and Power Company in Lake Forest second and third additions.

BATTLE MOUNTAIN, NEV.—A petition of the citizens of Battle Mountain for an extension of the lighting system has been referred to Commissioner Schmith.

RICHMOND, CAL.—Equipment is being hauled in for paving Twenty-third street from Macdonald avenue north. Electroliers will be placed along the street after it is paved.

CORVALLIS, ORE.—There is considerable agitation in Corvallis for a municipal lighting and power plant, and unless the rates of the Oregon Power Company are lowered the matter will no doubt be taken up through public meetings to determine if there is sufficient sentiment to start a campaign for a bonding election for this purpose. The flat rate in the city is 10 cents per kilowatt hour.

TRANSMISSION.

SALT LAKE CITY, UTAH.—Manager George Nichols says electrical machinery will soon be installed at the property of Lehi-Tintic Company in North Tintic District.

SALMON RIVER, CAL.—Carl Langford, superintendent of the electric power plant that will be installed at the mouth of Salmon river, has a crew of men at work. They will have to drive 100 ft. of tunnel before the power system can be installed.

WOODLAND, CAL.—The Northern California Power Company, Consolidated, has made application for a franchise to erect poles and wires for transmitting electric current in Yolo county. Sealed bids will be received for said franchise up to July 11th.

OKANOGAN, WASH.—The Similkameen Power Company plant has been sold to the Okanogan Valley Power Company for \$45,000 cash and 60 shares in the latter company at \$100 per share. The new owners announce that they will make considerable improvements both in plant and transmission line at an early date and will connect the plant with their Methow Valley plant.

FRESNO, CAL.—The San Joaquin Light and Power Company is preparing to make extensions in the Fresno district that will cost approximately \$75,000. It is reported that about 65 miles of new lines will be placed in the following towns: Fresno, Selma, Caruthers, Riverdale, Corcoran, Bakersfield, Midway, Santa Maria, Los Banos, Dinuba, Madera, Merced and Livingston.

TRANSPORTATION.

RENO, NEV.—Permission has been granted to the Reno Traction Company to lay tracks to the racetrack.

HILO, T. H.—The Hilo Electric Company has been bought out entirely by C. C. Kennedy and H. V. Patten.

LODI, CAL.—The Board of Trustees granted W. T. Owens permission to construct an electric railroad over certain streets of the city.

STOCKTON, CAL.—The Tidewater Southern, now operating an interurban electric line between Modesto and Stockton, may be extended to Turlock to tap that rich district as a feeder for the Western Pacific.

MARTINEZ, CAL.—The city trustees have granted a franchise to the Martinez-Concord Interurban Railroad to construct the first unit of the main line linking the two cities. The unit will cost about \$25,000.

PORTERVILLE, CAL.—It has become known that the extensions to be constructed south from Adobe station to the newly-opened orchards in the Deer Creek district will be constructed by the Pacific Electric Company and will be later leased to the Southern Pacific for operation.

SAN FRANCISCO, CAL.—The Board of Public Works will receive sealed bids up to June 28 for track special work for the Municipal Railways. It has been decided that work is to begin immediately in connecting the Van Ness avenue and Church street extensions of the Municipal Street Railway system by building tracks along Market street.

IRRIGATION.

SACRAMENTO, CAL.—W. O. Hamilton and C. M. Berry, president and secretary, respectively, of the Imperial Irrigation District, comprising 512,000 acres in Imperial County, were in Sacramento recently to consult with State officials relative to matters appertaining to the validation of the district's bonds of approximately \$3,500,000.

OAKDALE, CAL.—Plans for a joint storage reservoir with the Utica Mining Company were halted by the Oakdale irrigation board, when protests were received from the largest land owners in the district, who declared that the district has no present need of storage and insisted that it was folly to invest \$600,000 in the mining company's proposition when the stored water might not be used for ten years.

HANFORD, CAL.—R. H. Mills of the Kings County Development Company is busy getting signatures to the proposed Tulare Lake Water Reclamation District which comprises some 266,000 acres in Tulare Lake bottom. Mills will present the petition to the supervisors as soon as he has the required 51 per cent of names. It is proposed to issue \$6,000,000 worth of 20-year bonds.

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